v. 1

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. I.

MISSOURI
BOTANICAL
GARDEN.

PUBLISHED FOR THE CLUB.
NEW YORK.
MAY, 1889—MAY, 1890.

CONTENTS.

No. 1. PAGES.

Studies of the Types of various Species of the Genus *Carex*. By L. H. Bailey 1–86

No. 2.

Marine Algæ of the New Jersey Coast and adjacent waters of Staten Island. By Isaac C. Martindale 87–112

No. 3.

Hepaticæ Bolivianæ in Andibus Boliviæ orientalis, annis 1885–6, a cl. H. H. Rusby lectæ. By Richard Spruce 113–140

No. 4.

On Seedless Fruits. By E. Lewis Sturtevant 141–186

The numbers are each indexed separately.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. I. NO. 1.

Studies of the Types of various Species of the Genus Carex.

BY L. H. BAILEY.

ISSUED MAY 25th, 1889

PRICE, $1.00.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

Vol. I.] [No. 1.

STUDIES OF THE TYPES OF VARIOUS SPECIES OF THE GENUS CAREX.

Notes on Carex.—XI.*

By L. H. Bailey.

(Read Feb. 12, 1889),

An attempt has been made during the past year to see all the existing types of North American species of *Carex*. These types are widely scattered, largely in the Old World, and the whereabouts of many of them have been entirely unknown. Many of them had never been seen by a student of the genus since their publication, and there was reason to believe that some species which had been seen by our earlier botanists have not been properly comprehended in the light of our fuller knowledge. The examination has proved that many of our catalogued species are fictitious, and that considerable changes in nomenclature must be made. However much such radical changes are to be regretted, they are nevertheless unavoidable if priority of publication is to be considered; and there is the surety that in the future changes must be very few. The very oldest types have been seen, so far as they are known to exist, and almost every name which has been applied to North American species is accounted for and under-

* Earlier numbers were published as follows: I. Bot. Gaz. ix. 117–122, (Aug., 1884); II. Bot. Gaz. ix. 137–141, (Sept, 1884); III. Bot. Gaz. x. 203–208, (Jan., 1885); IV. Bot. Gaz. x. 293–295, (June, 1885); V. Bot. Gaz. x. 317–319, (Aug., 1885); VI. Bot. Gaz. x. 379–382, (Nov., 1885); VII. Proc. Amer. Acad. Arts and Sci. xxii. 59–157, (1886); VIII. Bot. Gaz. xi. 328–330, (Dec., 1886); IX. Bot. Gaz. xiii. 82–89, (Apr., 1888); X. Journ. Bot. xxvi. 321–323, (Nov., 1888).

stood. It is therefore evident that any further changes in the names of our species must be almost entirely such as rest upon judgments of the systematic merits of accepted species and varieties.

The writer upholds the use of the oldest published name or combination, in every instance. This principle is applied to the names of varieties with the same care as to those of species. He also adopts a particular variety as the type of each variable species, rather than use the specific name as a loose and collective appellation for all the forms of the species. This type, in every case, so far as originals exist, is the form which the author first described, independently of any apparent indications as to its relative importance. Thus some of our common species are emended; *e. g.*: *Carex straminea, C. laxiflora, C. striata, C. debilis, C. salina*, and others. The writer has given varietal names only to those forms which assume a considerable degree of permanence under various conditions, and the combining of which would lead to confusion in the knowledge of the species. He has no sympathy with that ultra-refinement of classification which gives names to specimens rather than to species and their larger variations. Such refinements serve no useful purpose, and do not merit the name of science. Few plants possess more clearly marked characteristics than do the Carices, when once the species are well understood and allowance is made for incidental variations; but when these incidental variations are confined by written descriptions and dignified by names, confusion unavoidably arises.

The collections to which the writer has had access are as follows, the abbreviation in the parenthesis being the character by which each is designated in the text below: 1. The collection of Linnæus (Hb. Linn.), deposited with the Linnæan Society, Piccadilly, London. The carices are comprised in three small fascicles, and are well preserved. Many of them possess little value, however, owing to the fact that they are not the specimens which Linnæus described. Some of the specimens are not named. 2. The large and valuable herbarium of Dr. Francis Boott (Hb. Boott.), now forming a part of the collections of Kew. 3. The herbarium of John Carey (Hb. Carey.), also at Kew. 4. That of Samuel Goodenough (Hb. Kew.), and, 5, of J. Gay (Hb. Kew.), both

at Kew. 6. The small but valuable collection of Edward Rudge (Hb. Kens.), at the Natural History Museum of the British Museum, at South Kensington, London. 7. The northern species described by Robert Brown (Hb. Kens.), at South Kensington. At South Kensington are also the herbaria of Thomas Walter, Ehrhart, Shuttleworth, and others. 8. The collection of Scandinavian plants made by Wahlenberg, at Upsala (Hb. Wahl.). At Upsala is also the herbarium of Thunberg. 9. A portion of Wahlenberg's North American species, deposited in the Naturhistoriska Riksmuseum at Stockholm, (Hb. Holm.). Some of Wahlenberg's types are not in existence, so far as known, but they are such as are pretty clearly defined by collateral evidence. The collection of Swartz, also at Stockholm, contains three of Wahlenberg's types. (*C. polystachya*, *C. cladostachya* and *C. scabrella.*). 10. The very complete and invaluable collection of arctic carices at Copenhagen (Hb. Havn.), comprising the types of Drejer, Lange, and others. 11. The types of the Mexican and Central American species founded by Liebmann, also at Copenhagen, in the herbaria of Liebmann (Hb. Liebm.) and Œrsted (Hb. Œrst.). 12. Willdenow's collections (Hb. Willd.) at Berlin. This herbarium contains most of the types of Muhlenberg and Schkuhr. The specimens were probably furnished entirely by Muhlenberg to Willdenow, and by Willdenow lent to Schkuhr. It appears from comparisons of Willdenow's specimens with Schkuhr's plates, that most if not all of the specimens from which the drawings were made, were returned to Willdenow. Duplicates were retained by Schkuhr. 13. The large general collections at the Imperial Botanic Museum at Berlin (Hb. Berol.), containing the types of Bœckeler, and some of those of Kunth, and other authors. 14. The collection of Schkuhr (Hb. Schk.) at Halle. 15. The specimens representing Presl's types of Reliquiæ Hænkeanæ, at Prague (Hb. Presl.). 16. The old herbarium of Allioni (Hb. All.) at Turin, Italy. Some of Allioni's types are not in existence, so far as known, and it appears that some of his species are founded solely upon Haller's descriptions. 17. The plants of Lamarck (Hb. Lam.) at the Jardin des Plantes, Paris. This invaluable collection has but recently been added to the large collections at Paris, by purchase from the estate of the

late Professor Rœper, of Rostock. 18. Michaux's collection (Hb. Michx.), also at Paris. 19. The general collection at the Jardin des Plantes (Hb. Paris.). 20. The herbarium of Steudel (Hb. Steud.), now in the possession of the Comte de Francqueville, and kept in Paris. I was allowed to inspect this collection through the courtesy of the proprietor, and his secretary, M. Jules Poisson. Many of the perplexing species of Steudel are not represented in his own herbarium. Those which are founded upon Drummond's collections, I have been able largely to identify at Kew, Berlin, and Cambridge, Mass. Two species described by Steudel and attributed to Chamisso are said, in the text, to have been founded upon specimens in the herbarium of Lenormand. I therefore went to Calvados, and found in, 21, the collection of Lenormand at Caen (Hb. Lenorm.), nearly all the remaining ambiguous species of Steudel. 22. The collections at Columbia College, New York (Hb. Torr.), in which are many types of American authors. 23. The collections at Harvard (Hb. Gray.), very rich in American material. 24. The herbarium of the late William Boott, now at Cambridge, Mass. 25. The collection of Schweinitz (Hb. Schw.), in the possession of the Philadelphia Academy of Sciences, and kindly loaned me by the Academy through the courtesy of the curator, J. H. Redfield. With this collection, I also had that of Zaccheus Collins. 26. Dewey's annotated and augmented set of Sartwell's Exsiccatæ, loaned me by the authorities of Williams College. In addition to these herbaria, I have had access to many smaller collections in many places. I have not been able to find the types of Scheele, but his descriptions leave little doubt as to the identity of his species.* Steudel's *Carex Preslii* (founded upon Presl's *C. leporina*), is not clearly accounted for.

The abbreviation v. s. (*vidi siccam*, " I have seen a dried specimen ") indicates that I have seen the original specimen upon which the species in question was founded. Following the description of a new species, I have added a number in parenthesis to indicate the position the species should occupy in my Synopsis. (Proc. Amer. Acad. Arts and Sci. xxii. 1886).

**C. tetrastachys, C. Rœmeriana, C. scaberrima. C. variegata.*

1.—CAREX CEPHALOIDEA, Dewey, Cat. Pl. Mass. 262 (1840), v. s.; Sartw. Exsicc. No. 21 (1848), v. s.

C. muricata, L., var. *cephaloidea*, Dewey, Sill. Journ. (I.) xi. 308 (1826).

C. cephalophora, Muhl., var. (?) β., Torr. Monog. 289 (1836).

C. sparganioides, Muhl., var. *cephaloidea*, Carey, Gray's Man. 1st. Ed. 513 (1848) v. s. Hb. Carey.

Distinguished from *C. cephalophora*, Muhl., with which it is commonly confounded, by its greater size, much broader leaves, its more numerous (5 to 10) spikes, which are disposed in an interrupted head an inch or more long, and larger and longer-pointed perigynia and shorter scales. It also resembles small and short headed forms of *C. sparganioides*, Muhl., from which, however, it appears to be abundantly distinct. In some cases it counterfeits *C. straminea*, Schk. var. *mirabilis*, Tuckm., but is at once separated by the position of the staminate flowers.— Copses, mostly in shade, from Western Massachusetts to Michigan. (251a).

This species has been a source of great perplexity to students of the genus, owing, as it now transpires, to the fact that two species have been united by some, and that the name has been wholly transferred from one species to the other by others. Boott describes another species as *C. cephaloidea*, and Dewey himself accepted the transfer of the name (Sill. Journ. 1866, 326), and left his original species nameless. The other species, with which this has been confounded, may be called—

2.—CAREX GRAVIDA.

C. cephaloidea, Sartw. Exsicc. No. 75 (1848), v. s.; Boott, Ill. 123 t. 395 (1862), v. s. Hb. Boott.; Dewey, Sill. Journ. (II.), xli. 326 (1866); Olney, Exsicc. fasc. iv. No. 15 (1871), v. s.; Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 141 (1886).

Most like *C. alopecoidea*, Tuckm.: culm thinner, more sharply three-angled; spikes few (four to seven), globular or broader than long, all contiguous and forming a small and oblong simple head; perigynium about twice larger than in *C. alopecoidea*, not stipitate, more abruptly contracted at the top, gravid, somewhat polished, conspicuously spreading; leaves narrow and very long-pointed. (239a).

Northern Illinois, *Vasey*, *Bebb*, to Northwestern Iowa, *Cratty*.

Var. LAXIFOLIA.

Much larger (2 to 3½ ft. high), the leaves broad and lax, and much less conspicuously pointed than in the species; head large and dense, ovoid or oblong, scarcely interrupted.

Northern Illinois, *Bebb*, Martin Co., Minn., *Cratty*, Fort Pierre, Dakota, *Hayden*, Wyoming, *Mc Shea*. Possibly specifically distinct.

3.—CAREX SPRETA.

C. stylosa, Meyer, var. *virens*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 79 (1886).

Larger and stouter than *C. stylosa* (18 in. high), and the leaves broader and longer; spikes short and thick (a half inch or less long), all closely sessile, the upper two or three contiguous to the staminate spike; perigynium very broad, thin, green, nerveless, longer and much broader than the black and muticous, faintly white-nerved scale. (63a).

Sauvie's Island, Oregon, *Howell*. Said by Howell to form part of the sedge pasturage of the Columbia.

4.—CAREX ELEOCHARIS.

One of the Vigneæ, perhaps allied to *C. tenella*, Schk.: Very slender but stiff, half a foot high, both leaves and culm filiform and smooth; spikes two or three, each bearing from one to three flowers, closely aggregated into a very small and apparently monostachyous head, evidently staminate above; perigynium short-ovate, turgid, flat on the inner face, marginless and nerveless, dull brown, beak entire or nearly so, as long as or longer than the thin-hyaline scale (247a ?).

Saskatchewan Plains, 1872, *Macoun*, No. 1665; distributed as *C. glareosa*, Wahl. A singular and ambiguous little species (Hb. Kew. and Hb. Bailey.).

5.—CAREX EXSICCATA.

C. vesicaria, L., var. *major*, Boott, Hook. Fl. Bor. Am. ii. 221 (1840).

C. vesicaria, L., var. *β.*, Boott, Ill. 162 t. 537 (1867), v. s. Hb. Boott.

C. vesicaria, L., var. *lanceolata*, Olney, Proc. Amer. Acad. Arts and Sci. viii. 407 (1872), v. s. Hb. Gray.

Differs at once from *C. vesicaria* by its greater size and broader leaves, thicker and more nearly sessile spikes, and particularly by the much longer, lance-ovate, scarcely inflated, duller

and strongly nerved perigynium, which is three to four times longer than the very narrow and muticous scale. In some of its forms it strongly suggests *C. trichocarpa*, Muhl., var. *aristata*, Bailey (21a).

Oregon, *Hall*, Sauvie's Island, *Howell*, base of Mt. Hood, *Henderson*.

Var. GLOBOSA.

C. vesicaria, L., var. *globosa*, Olney, Proc. Amer. Acad. Arts and Sci. viii. 408 (1872), v. s. Hb. Gray.

More slender than the species, the leaves narrow (1/3 in. or less wide); spikes small (an inch or less long), more or less scattered, closely sessile, rusty in color; perigynium narrower, conspicuously spreading; scale hyaline and very small.—Oregon, *Hall*, base of Mt. Hood, *Henderson*, Mt. Adams, Washington, *Howell*, Vancouver Island, *Macoun*.

Var. PUNGENS.

Slender; spikes narrowly cylindrical (the size of a pencil), one to two inches long, usually dark colored; scales firm, very sharp pointed, half or a third as long as the perigynium.—Wet places, Vancouver Island, 1887, *Macoun*, Nos. 46 and 47.

6.—CAREX SALTUENSIS.

C. vaginata, Tausch, var. *alto-caulis*, Dewey, Sill. Jour. (II.), xli. 227 (1866).

C. vaginata, Gray, Man., 5th ed., 586 (1868) and all American authors.

C. panicea, L., var. *refracta*, Olney, Exsicc. fasc. i. No. 24 (1871).

The study of much material leads me to separate this American species from the European *C. vaginata*, Tausch. I have also seen *C. vaginata* growing in Scotland, and again in Germany; the American species in its native woods is familiar. When our species was first discovered in the United States, by J. A. Paine, in 1865, Professor Dewey drew characters of separation between it and the European plant, but with the meagre material at his command, elevated the distinctions only to varietal value. From the European plant, *C. saltuensis* is separated by its much more slender and less cæspitose habit, narrower leaves and less conspicuous sheaths, its alternately-flowered spikes, and its much smaller, less inflated, and conspicuously nerved perigynium.—Labrador, *Turner*, to Northern Vermont, *Pringle*, Western New

York, *Paine*, Michigan, Minnesota, and westward to McLeod's Lake, British Columbia, lat. 55°, *Macoun.*

7.—CAREX SARTWELLII, Dewey, Sill. Journ. (I.) xliii. 90, (1842) ; Sartw. Exsicc. No. 12 (1848).

C. intermedia, Dewey, Sill. Journ. (II.) iv. 343 (1847) in part.

C. disticha, Sartw. Exsicc. No. 71 (1848); Boott, Ill. t. 410, excl. f. 2 (1862); Olney, Exsicc. fasc. iv. No. 26 (1871) v. s. and American authors in general.

C. disticha, Huds. var. *Sartwellii*, Dewey, Sill. Journ. (II.) xli. 330 (1866).

The American plant is abundantly distinct from the European *C. disticha*, Huds., although Dewey declared (Sill. Journ. 1866, 330) that "specimens precisely like the varying forms of *C. Sartwellii* have come to me from the north of Europe," and Boott (Ill. 126) could "see no characters to distinguish *C. Sartwellii* from the European *C. disticha*." Dr. Boott, however, was well aware of the differences between the two species, and pointed them out, but intermediate specimens from France and Germany confounded him. All these intermediate forms are immature, but they are nevertheless clearly distinct from the American plant. The European forms which closely approach *C. Sartwellii* are poorly developed and uncharacteristic specimens. Our plant is distinguished as follows: Plant more strict; spikes much shorter and rounder (ovate-oblong and pointed in *C. disticha*), about equally developed throughout and giving the lighter colored head a narrower and more symmetrical outline (in *C. disticha* the lower spikes are most fully developed, and the whole upper part of the head is often staminate, causing the head to appear bushy); perigynium much shorter and smaller, less prominently nerved.—New York to Utah and Montana, and British America.

Carex Sartwelliana, Olney, Proc. Amer. Acad. Arts and Sci. vii. 396 (1868), may be known as CAREX YOSEMITANA.

8.—CAREX COREANA.

C. retrorsa, Schw., var. *minor*, Boott, in herb. distrib.

Culm erect and stout, a foot or foot and a half high, smooth; leaves broad, shorter than the culm; lower bract broad and erect and much surpassing the culm; spikes one to three, short and

thick (an inch long and half or more as broad), sessile, or the lowest sometimes short stalked, approximated or aggregated; perigynium turgid and many-nerved, shining, straw-colored, thin, ascending, produced into a conspicuous and toothed beak; scale short ovate, blunt or muticous and hispidulous at the tip.—Port Chusan, Corea, 1859, *C. Wilford*, No. 927. Hb. Boott., Hb. Kew. and Hb. Berol. Its nearest ally is *C. bullata*, Schk.

9.—CAREX CALIFORNICA.

C. polymorpha, W. Boott, Bot. Calif. ii. 247 (1880), v. s. Hb. Torr. and Hb. Gray.

Differs from *C. polymorpha*, Muhl., in its smaller size and more slender habit, and much narrower leaves, and particularly by its nearly entire and much shorter beaked perigynia. (170a). Mendocino, California, *Bolander*, 4741.

10.—CAREX ALBIDA.

C. Cherokeensis, W. Boott, Bot. Calif. ii. 248 (1880), v. s.

Allied to *C. gynodynama*, Olney, and *C. luzulina*, Olney: Leaves narrow, smooth or slightly rough on the edges; spikes scattered, very short (about half an inch), whitish, the two staminate stalked, the pistillate sessile or nearly so; perigynium very gradually beaked (lance-ovate), the teeth small and erect, inconspicuously nerved, rough on the angles above; scales white-hyaline with a very thin margin, broadly ovate and obtuse or very abruptly short-pointed, the tip hairy, shorter than the perigynium. (94a). California, Santa Rosa Creek, *Thurber*, *Bigelow* (Hb. Boott. and Hb. Torr.)

11.—CAREX PERTENUIS.

One of the *Polystachyæ*: Plant bright green, the lower sheaths dark brown, slender, a foot to a foot and a half high, the culm smooth; leaves long-pointed, finely and sharply serrate on the margins, usually somewhat shorter than the culm; bracts sheathing, the lowest leafy and surpassing the culm; spikes four or five, very slender (1½ to 3 inches long), on filiform peduncles an inch or so long, divergent or drooping, alternately flowered below, the staminate portion (at the apex) short; perigynium elliptic, trigonous, pointed at both ends, sometimes slightly curved, the orifice entire, smooth and green, finely striate, somewhat longer than the broad and brown abruptly rough-awned scale. (108a). Orizaba, Mexico, Müller 1337 and 1338, Hb. Kew., Hb. Paris. and Hb. Torr.

12.—CAREX NOVA, Bailey, Journ. Bot. xxvi. 322 (1888).

C. nigra, Olney, Exsicc. fasc. v. 24 (1871), v. s.

C. atrata, L., var. *nigra*, Olney, Bot. King's Rep. 371 (1871); W. Boott, Bot. Calif. ii. 239 (1880); Bailey, Coulter's Man. 388 (1885), Proc. Amer. Acad. Arts and Sci. xxii. 77 (1886.)

Differs constantly from *C. atrata*, L., as follows: Spikes three or four, globular, strictly sessile, and very densely aggregated into an ovoid-triangular head, the lower spikes of which are squarrose, or the lower one rarely distinct; perigynium broadly ovate or nearly circular in outline, thin and whitish, very conspicuously squarrose, broader than the ovate and muticous black scale. (50a.) Mountains, Colorado to California.

13.—CAREX ATRATA, L., var. OVATA, Boott, Ill. 114, t. 362 (1862), Bailey, Journ. Bot. xxvi. 321 (1888).

C. ovata, Rudge, Linn. Trans. vii. 96, t. 9 (1804), v. s. Hb. Kens.

C. atrata, American authors.

Habitually more slender than the species and usually lower; spikes small, oblong or oblong-ovate, reddish-brown, slenderly peduncled. White Mountains, Smuggler's Notch, Vermont, *Brainerd*, and Labrador, Hb. Rudge.

Var. DISCOLOR, Bailey, Journ. Bot. xxvi. 321 (1888).

C. atrata, L., var., W. Boott, Wheeler's Survey 100th Merid. vii. 278 (1878) v. s. Hb. Gray.

C. atrata, var. *ovata*, Bailey, Coulter's Man. 388 (1885), Proc. Amer. Acad. Arts and Sci. xxii. 77 (1886).

Tall and slender; spikes narrowly cylindrical (an inch or two long and a fourth inch or less wide), the lower one or two on slender peduncles or even radical, the terminal one bearing a very long and much contracted staminate portion; perigynium greenish-white, conspicuously broader and usually longer than the black-purple and faintly white-nerved scale. A pretty plant. Colorado to Arizona, on the mountains.

14.—CAREX LURIDA, Wahl., Köngl. Acad. Handl. xxiv. 153 (1803), v. s. Hb. Holm.

C. tentaculata, Muhl.; Willd. Sp. Pl. iv. 266 (1805); Schk.,

Riedgr. Nachtr. 53, t. Ggg. f. 130 (1806); v. s. Hb. Willd. and Hb. Schk. (Founded upon abnormal specimens).

C. rostrata, Willd., Sp. Pl. iv. 282 (1805), v. s. Hb. Willd. and Hb. Schk.

C. gigantea, Kunth, Enum. Pl. ii. 503 (1837), v. s. Hb. Berol.

C. Purshii, Olney, Exsicc. fasc. i. No. 30 (1871), v. s.

C. Beyrichiana, Boeckl., Linnæa, xli. 239 (1876), v. s. Hb. Berol.

Nine years after Wahlenberg had published his *Carex lurida*, he stated (Fl. Lapp. 250) that it is the same as Schkuhr's figure of *C. lupulina*, Muhl. I therefore used his name for *C. lupulina* in my Synopsis (Proc. Amer. Acad. Arts and Sci. xxii. 63, 1886). In the Riksmuseum there are two sheets labelled *C. lurida* by Wahlenberg. One is from Hultgren, the original collector, and from this the description is made. This plant is the *C. tentaculata* of Muhl.! The other sheet, evidently a later acquisition, is from Muhlenberg, and is *C. lupulina*, Muhl., var. *pedunculata*, Dewey. It is evident that Wahlenberg confounded the two species. *C. lurida* is a variable species, particularly in the size and shape of the spikes, but I am able to separate only one form as worthy varietal recognition:

✓ Var. GRACILIS.

C. tentaculata, Muhl., var. *gracilis*, Boott, Ill. 94 (1860).

Small and slender, bearing about two small erect pistillate spikes which are densely cylindrical and very narrow. Mountains of Vermont and New Hampshire, and in Pennsylvania and Tennessee.

15.—CAREX LUPULINA, Muhl., Willd. Sp. Pl. iv. 266 (1805); Schk., Riedgr., Nachtr. 54, tt. Ddd. f. 123; Iii. f. 194 (1806); v. s. Hb. Willd. and Hb. Schk.

C. lurida, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 63 (1886).

Carex lupulina is a variable and perplexing species. The type is characterized by its very thick and short spikes (1½ to 2 inches long and an inch or more wide), which are strictly sessile, or the lower one short-peduncled, and contiguous into a great

bunchy head; staminate spike small and sessile, usually partially hidden in the head; perigynium large and much inflated, conspicuously ascending. From this hop-headed form (whence its name), which is comparatively uncommon, the species runs almost imperceptibly into many more slender variations. Those worthy of varietal distinction are as follows:

Var. BELLA-VILLA.

C. Bella-villa, Dewey, Sill. Journ. (II.) xli. 229 (1866), v. s.
C. lurida, var. *divergens*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 63 (1886).

Plant much more slender; spikes scattered or remote, oblong or cylindrical, loosely flowered and more or less staminate at the apex; perigynium much more slender and more gradually beaked, more straw-colored, diverging at right angles; scales longer and conspicuously awned. This singular plant has nearly as much the aspect, in its spikes and perigynia, of *C. folliculata* as of *C. lupulina*, and in my Synopsis I suggested that it may be a hybrid of the two species. Professor Macoun states, however, (Cat. Can. Pl. iv. 168, 1888), that "it cannot be a hybrid with *C. folliculata*, as that species has never been found within one hundred miles of the locality." Near Belleville, Hastings Co., Ontario, *Macoun*.

Var. PEDUNCULATA, Dewey, Wood's Bot. and Fl. 376 (1870).

C. folliculata, Lam., Dict. Bot. iii. 391 (1789), v. s. Hb. Lam.
C. gigantea, Rudge, Linn. Trans. vii. 99 f. 2 (1804), v. s. Hb. Kens.
C. Canadensis, Dewey, Sill. Journ. (II.) xli. 229 (1866), v. s.
C. lupulina, var. *longipedunculata*, Sartw. in herb.; Dudley, Cayuga Fl., 119 (1886), v. s. Hb. Cornell.
C. lurida, Wahl., var. *polystachya*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 63 (1886), mostly.

Usually more slender than the species; spikes much narrower and smaller, (½ to ¾ in. wide and ½ to 2 in. long), more or less scattered, a part or all of them peduncled, the lower ones sometimes long-exserted; staminate spike usually conspicuous, often long-peduncled; perigynium usually smaller. A polymorphous variety, more common than the species, extending from Canada

to the Gulf. It is commonly mistaken in its larger forms for the:

Var. POLYSTACHYA, Schw. and Torr., Monogr. 337 (1825), v. s. Hb. Schw.

C. lupuliformis, Sartw. Exsicc. No. 147 (1848), v. s.; Boott, Ill. 61, t. 163.

C. lurida, Wahl., var. *polystachya*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 63 (1886), in part.

Stout and very leafy; spikes four to six, very large and heavy at maturity, but narrower than in the species (2 to 4 in. long and ¾ in. wide), cylindrical, alternately disposed, all, or particularly the lower, short-peduncled, erect, the lowest one or two subtended by broad, leafy bracts which far exceed the culm; staminate spike 2 to 4 inches long, sessile, or at least not conspicuously peduncled; perigynium large and much inflated, somewhat spreading, bright straw-colored at full maturity; scales hispid at the tip. The characters which particularly distinguish this plant from var. *pedunculata* are the long and cylindrical spikes, the great bracts, shorter peduncled staminate spike, and more spreading perigynia. Distinct in appearance. New York and New Jersey; not common.

15*a*.—C. LUPULINA × RETRORSA, Dudley, Cayuga Flora, 119 (1886), v. s. Hb. Cornell.

C lupulina, var. *gigantoidea*, Dewey, Sill. Journ. (II.) xli. 328 (1866).

C. lurida × retrorsa, Bailey, Bot. Gaz. xiii. 88 (1888).

✓16.—CAREX GRANDIS.

C. gigantea, Dewey, Sill. Journ. (I.), xi. 164 (1826), (II.) xli. 329 (1866), Wood's Class Book, 1860, 767; Boott, Ill. 61, t. 164 (1858), v. s. Hb. Boott.; Carey, Gray's Man, 4th. ed. 533 (1862), v. s. Hb. Gray.; Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 64 (1886).

Very like *C. lupulina*, Muhl., var. *polystachya*, Schw. & Torr., from which it is distinguished by its much more scattered and slim spikes, which are more loosely flowered; perigynium very abruptly contracted into a slender beak three or four times as long as the body, spreading at right angles or very nearly so, little inflated, never becoming straw-colored; scales narrower, smooth. A much more graceful carex than the other, with mature specimens of which it can never be confounded. Boott's

figures distinguish the two admirably. Kentucky, *Short*, Delaware, *Canby*, *Commons*, and southward.

17.—CAREX HOODII, Boott, Hook. Fl. Bor.-Am. ii. 211, t. 211 (1840), and Ill. 17 (Excl. Thurber's No. 16), t. 46 (1858), v. s. Hb. Boott.

C. muricata, Linn., var. *confixa*, Bailey, Bot. Gaz. x. 203 (1885).

Tall and slender, but erect, the culm (1 to 2 ft. high) prolonged beyond the leaves; spikes several to many, very few-flowered, compacted into an ovoid or oblong head three-fourths inch or less long; perigynium spreading, small and narrow, gradually contracted at both ends, green, nerveless or nearly so, conspicuously green-wing-margined, rough on the angles, about the length of the brown or tawny scale. (239b.) Montana, Idaho, Oregon and Washington.

√ Var. NERVOSA.

Very tall and slender, (2 to 3 feet high); head looser; perigynium browner throughout, more prominently winged, conspicuously nerved on the outer face. California, *Kellogg* and *Harford*, 1069; Marsh at Seattle, Washington, *Howell*.

18.—CAREX OCCIDENTALIS.

C. muricata, Olney, Bot. King's Rep. 362, in part (1871); W. Boott, Bot. Wheeler's Surv. 277 (1878); Bailey, Coulter's Man. 390 (1885).

C. muricata, L., var. *Americana*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 140 (1886).

Glaucous; leaves narrower than in the last, and relatively longer; spikes more or less scattered into a very slender head an inch or so long, the lowest one or two usually wholly distinct; bracts scale-like, inconspicuous; perigynium larger than in the last, turgid-ovate, abruptly short-beaked, nearly marginless and often smooth; scales muticous. (239c.) Mountains, Montana to Arizona.

19.—CAREX HOOKERIANA, Dewey, Sill. Journ. (I.) xxix. 248, f. 75 (1836).

C. muricata, L., var. *gracilis*, Boott, Ill. 193.

Very slender; head interrupted, castaneous, small, the spikes sometimes alternately arranged; bracts of the two or three lower spikes produced into long awns, which surpass the spikes; peri-

gynium small, green, usually lightly nerved, gradually produced into a beak which is cut into sharp awl-like teeth. (238a.) Utah to California and northward.

20.—CAREX TENUIROSTRIS, Olney, Parry's Bot. Obs. in W. Wyoming, in Amer. Nat. 1874, 24, v. s. Hb. Gray.*

C. Bonplandii, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 152 (1886).

To be compared with *Carex festiva*, Dew. and *C. Preslii*, Steud. Low (3 to 8 in. high), stiff and erect, the leaves very narrow and long-pointed, somewhat shorter than the culm; head small, ovate (a half inch or less long), very light brown; perigynium lanceolate and nearly terete below, slightly concave but marginless above, gradually narrowed into a point, lightly many-nerved, (particularly on the back), about the length of the lanceolate and acute hyaline-margined scale. (287a.) I have seen Kunth's original *C. Bonplandii* at Berlin, and it is essentially different from this plant. So far as I can judge from materials at my command, Boott's *C. Purdiei* is distinct from *C. Bonplandii*, although referred to that species by himself. The peculiar boat-shaped and marginless perigynia of *C. tenuirostris* distinguish it from both the above South American species, and from *C. festiva* and *C. Preslii*. N. W. Wyoming, *Parry*, 284, and Summit Valley, Cal., *Pringle*.

21.—CAREX ILLOTA.

C. Bonplandii, Kunth ? var. *minor*, Boott, Proc. Acad. Phila. 1863, 77, v. s. Hb. Gray.; Olney, Bot. King's Rep. 365 (1871), v. s. Hb. Gray., and Exsicc. fasc. 3, No. 3 (1871), v. s.

C. Bonplandii, var. *angustifolia*, W. Boott, Bot. Calif. ii. 233 (1880), v. s. Hb. Gray.; Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 153 (1886).

Distinguished from small forms of *C. festiva*, Dew., as follows: Very slender and usually tall (6 in. to 19 in.), the head very small and globular or short-oblong (1/3 in. or less in diameter); perigynium completely marginless, thick below, stipitate, nerved, entirely smooth on the edges, the cylindrical and scarcely-cut beak projecting beyond the obtuse or muticous dark brown scale.

* *Carex tenuirostris*, Bœckl. is a more recent species.

(270a.) The perigynia are considerably like those of the *C. canescens* group. The species stands midway between *C. festiva* and *C. Heleonastes.* Mountains, Colorado to California; evidently not common. I have seen the original of *C. Bonplandii* var. *angustifolia*, Boott, from South America, and it bears no immediate relation to this plant. Boott, in founding his *C. Bonplandii* var. *minor*, remarks, "perigyniis ad marginis rarissime scabris," but his specimens have perfectly smooth fruit. He must have confounded with them some of the weak forms of *C. festiva.*

22.—CAREX JONESII.

Allied to *C. nervina*, Bailey, and *C. stipata*, Muhl.: Slender, but erect and somewhat stiff (7 to 18 in. high); culm sharply angled and rough, somewhat exceeding the narrow leaves; spikes several to many, densely aggregated into a small oblong or ovoid head (an inch or less long), which is bractless; perigynium small, lanceolate from a truncate base, stipitate, very strongly many-nerved, marginless, smooth or but slightly rough on the angles above, the long and brown beak nearly entire; scale brown, muticous or obtuse, somewhat shorter than the perigynium. Readily distinguished from *C. nervina* by its narrow and sharp culm, narrow leaves, simple head, and the absence of sponginess at the base of the perigynium. (230a.) Soda Springs, Nevada Co., Cal., 7,000 feet, 1881, *M. E. Jones;* Cascade Mts. 4,000 feet, Washington, 1882, *Tweedy.* Hb. Bailey.

23.—CAREX NUDATA, W. Boott, var. ANGUSTIFOLIA.

C. aperta, Boott, var. *angustifolia*, Boott, Hook. Fl. Bor.-Am. ii. 218 (1840), v. s. Hb. Boott., and Hb. Gray.

C. cæspitosa, L., var. *filifolia*, Boott in part, Ill. 182 (1867); Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 80 (1886).

Differs from *C. nudata* in its much more slender and lax habit, and narrower leaves; spikes short (¾ in. or less), sessile or nearly so; perigynium shorter and relatively broader, much more abruptly contracted above, faintly nerved. The leading feature of *C. nudata* is its slim, almost lanceolate perigynium, which is empty above. Fort Good Hope, Mackenzie's River, lat. 67°, *Richardson;* Cascade Mountains, about lat. 49°, *Lyall;* Trask River, Tillamook, Oregon, *Howell, Henderson.*

Carex cæspitosa, L., does not occur in America, so far as known. I inserted it in my Synopsis (1886, p. 80), upon the authority both of Drejer (Greenland), and Dr. Boott. The plant

referred here by Drejer (Rev. Crit. Car. Bor. 37, 38) is *C. vulgaris*, Fries (v. s. Hb. Havn., and teste Lange). Lange, Fl. Groen. i. 144, remarks, "Neque *C. stricta*, Good., neque vera *C. cæspitosa*, L. (*C. Pacifica*, Drej.) in Groenlandia unquam lectæ sunt." The specimens referred to this species by Boott are too young for determination, although it is certain that they are not *C. cæspitosa*, L. Bœckeler says that the species occurs in British America, but the remark is without foundation. Last autumn I made the acquaintance of *C. cæspitosa*, growing in Norway; there are no North American plants, which I have seen, that can be referred to any form of this species.

Var. ANOMALA.

Very slender (18 in. to 30 in. high), the culm and leaves very rough; leaves very numerous and long and narrow; spikes three to five, the lowest one or two on long and very slender peduncles, very narrow and thinly-flowered at base (one to two inches long), greenish or brownish (never purple-black as in the species and the last variety), the terminal one often pistillate at the top or throughout; perigynium firmer in texture, long and often very slender, granular and prominently nerved, green or greenish-yellow, longer than the narrow and brown obtuse scale. Oregon: Cascade Mountains, *Howell* (distr. as *C. lenticularis*, Michx.); Lost Lake, *Henderson*, 1786. Often has the aspect of *C. prasina*, Wahl.

24.—CAREX KELLOGGII, W. Boott, Bot. Cal. ii. 240 (1880), v. s. Hb. Gray.

C. acuta, L. var. *pallida*, Boott, Ill. 166, v. s.

C. vulgaris, Fries, var. *juncella*, Olney, in part, and excl. syn., Bot. King's Rep. 368 (1871); Bailey, Coulter's Man. 386 (1885).

This plant is not the *C. vulgaris* var. *juncella* of Fries, authentic specimens of which I have seen. Neither is it certain that our plant merits specific rank, although for the present it may be thus treated. It appears to be nearer *C. lenticularis*, Michx., than *C. vulgaris*, and is probably to be regarded as the western form of the former. The profuse and long-pointed leaves and essential characters of the perigynium point strongly to such a relationship. On the other hand, it is distinguished from *C. lenticularis* by its greenness, scattered spikes, always wholly staminate terminal spike, and longer pointed and stronger nerved green

perigynium. Indeed, it is doubtful if most of the western plants which have been referred to *C. vulgaris* do not belong to this apparently green form of *C. lenticularis.* Undoubted *C. lenticularis* was collected in 1858 by Lyall, in the Oregon Boundary Survey (Sumass Prairie, 49°), and probably Brewer's 2099, from California, is the same.

Another plant which has been referred to *C. lenticularis*, in California, seems to merit provisionally, at least, the following disposal:

25.—CAREX INTERRUPTA, Bœckl., var. IMPRESSA.

Spikes mostly shorter (usually an inch or less), little or not at all attenuated at the base, the lowest one not as long-peduncled; perigynium considerably larger, strongly few-nerved.—Summit Camp, Cal., *Kellogg*, Yosemite Valley, *Bolander*, 6198, p.p. The plant provisionally referred, in my Synopsis (p. 87), to *C. acuta* var. *pallida*, Boott, said to have been collected in Maine by Blake or Porter, and distributed by Olney as *C. lenticularis*, is *C. interrupta*, var. *impressa.* The plant apparently belongs to Kellogg's collection, coming into some of Olney's sets by mistake.

26.—CAREX VARIABILIS.

C. limula, Olney, Bot. King's Rep. 367 (1871) v. s. Hb. Gray.
C. aquatilis, W. Boott, Bot. Wheeler's Surv. 277 (1878) v. s. Hb. Gray.
C. aquatilis, var. W. Boott, l. c., v. s. Hb. Gray.
C. stricta, Bailey, Coulter's Man. 385 (1885).
C. aperta, Boott, var. *divaricata*, Bailey, l. c.

Glaucous; mostly low (2 ft. or less high), stout; culm sharply angled, roughish on the angles; leaves rather broad (as compared with *C. stricta*, Lam.); spikes three or four, short and stout (2 in. or less long), borne near the top of the culm, erect, the lower one or two conspicuously attenuated at the base, and appearing clavate, the upper sessile, lower peduncled; bracts leaf-like and broad, the lower one or two equalling or exceeding the culm; perigynium small and broadly ovate, abruptly and very shortly beaked, nerveless, beak entire, green or whitish, conspicuously broader and usually shorter than the obtuse or muticous black scale. (*72a*). Colorado, *Vasey* 582, *Hall* & *Harbour* 616 in

part, *Parry*, Twin Lakes, *Wolf* 1037, alpine bogs, Leadville and Ute Pass, *Trelease*, wet places near Empire, 8,500 ft., and damp places along Clear Creek, 8–9,000 ft., *Patterson*. Wyoming, *Parry* 279, Yellowstone Falls, *Letterman*.

Var. ELATIOR.

Much taller, the leaves very long and narrower; spikes longer (often 3 to 4 in.) and more slender, the lower much attenuated below, the upper bearing conspicuous staminate portions; bracts long and narrow. Canon City, Colorado, *Brandegee*; open thickets, Morley, "Foot-hills of Rocky Mts.," and Donald, Columbia Valley, B. C., *Macoun*.

Carex stricta, Lam., and its var. *decora*, Bailey, do not occur west of Nebraska, so far as I am aware.* Many unsatisfactory specimens have been referred to this species by various writers, but as fast as complete and abundant specimens come to hand, they are easily placed elsewhere. *C. variabilis* appears to be abundantly distinct from all other species, but the var. *elatior* varies towards *C. stricta*, var. *Emoryi*, Bailey, and *C. aquatilis*, Wahl. From the former, the above characterizations readily distinguish it. *C. aquatilis* is marked by its abundance of comparatively broad and long leaves and bracts, the solid spikes, very broad perigynia, and minor characters; its limits, particularly in our West, are very imperfectly understood, and material is yet scant.

27.—CAREX AURICULATA.

C. Jamesii, W. Boott, in part, Bot. Cal. ii. 243 (1880) v. s. Hb. Gray.

Between *C. stricta*, Lam., and *C. Nebraskensis*, Dewey: Culm slender but erect, sharply angled, mostly longer than the long-pointed leaves (2 ft. high); staminate spike one (or a rudimentary one sometimes borne at its base), short (½ to 1 inch long), short-peduncled; pistillate spikes two to four, short (an inch or less long, or the lowest sometimes longer and somewhat attenuated below), closely sessile or the lowest one very short peduncled, cylindrical and closely flowered, the lowest usually subtended by a leafy, slender bract two or three inches long the base of which is normally somewhat hyaline and dilated, the other spikes

*C. *angustata*, W. Boott, Bot. Cal. ii. 242 (v. s. Hb. Gray.) appears to be a narrow-spiked form of *C. Hallii*, Bailey.

closely subtended by a very short (2 to 3 lines) and broad white hyaline auricle; perigynium small, ovate, flat and soft, gradually narrowed into a very short and entire beak, finely puncticulate, very lightly few-nerved or nerveless, much longer and broader than the obtuse and black broadly white-nerved scale. (73a.) California: Coloma, *N. J. Andersson*, 1852, Hb. Holm.; Clark's Ranch and Yosemite Valley, *Bolander* 6208 and 6212. The specimens at Stockholm, represented by three full sheets, and which I take as the type, differ in no important respect from those collected by Bolander. The leaves are somewhat rougher, and the base of the bract is more prominently auricled.

√ 28.—CAREX USTA.

C. Douglasii, Boott, var. *brunnea*, Olney, Bot. King's Rep 363 (1871) v. s. Hb. Gray.; W. Boott, Bot. Cal. ii. 231 (1880· v. s. Hb. Gray.; Bailey, Coulter's Man., 393 (1885), Proc. Amer. Acad. Arts and Sci. xxii. 138 (1886).

Culm slender (one to two feet high) roughish above, mostly longer than the narrow leaves; spikes five to ten, staminate above, the lower two or three distinct, the remainder aggregated, the whole forming an interrupted narrowly oblong fulvous head two inches or less long; bracts dilated and scale-like, acuminate, fulvous, shorter than the spike, or the lowest one sometimes longer; perigynium lance-ovate, narrowly margined, hairy on the angles above, produced into a long and minutely toothed beak; scales thin, brown, hyaline-margined, obtuse or muticous, longer than the perigynium. (242a). Carson City, Nevada, *Watson* 1226; California, *Bolander* 4549 and 4550; also Bolander 4503, *teste* Olney and W. Boott, and Coulter 805, California, *teste* Olney. This plant bears no immediate relation to *C. Douglasii*, Boott, and its reference to that species is so manifestly erroneous that I venture the present disposition, although all the specimens are immature. *C. Douglasii* is diœcious, has large and congested heads, which are greenish-white in color, smooth perigynia, which are minutely cleft on the back of the beak, and excessively long styles, all of which characters separate it widely from the plant in question. The long styles of *C. Douglasii* break off as the plant matures, and this excellent specific character is commonly overlooked. *C. usta* is evidently allied to *C. leiorhyncha*, Meyer.

√ 29.—CAREX DOUGLASII, Boott, var.? LAXIFLORA.

Taller and more slender than the species (18 inches high);

head browner and loose; spikes much fewer, large, spreading, relatively loosely flowered; perigynium rough on the angles above, broad; styles shorter. Near Utica, Montana, *R. S. Williams*, 1888. In this plant all the flowers and scales stand out distinctly and loosely, while in the species they are compacted into a nearly continuous mass.

30.—CAREX SPECIFICA.

C. scoparia, Schk., var. *fulva*, W. Boott, mostly, Bot. Cal. ii. 237 (1880) v. s. Hb. Gray.; Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 148 (1886).

Tall and stout (2 to 3 feet); culm broad, smooth, longer than the broad and short pointed leaves, much less stiff than in *C. Liddoni*; spikes densely aggregated into a large ovoid or oblong head (1 ½ inches or less long), or rarely the lower ones distinct, subtended by broad but inconspicuous short and scale-like bracts, fulvous and dull in color; perigynium long-ovate, prominently nerved on both sides, margined, the edges rough, prolonged into a slender and minutely toothed beak, but half filled by the achenium; scales thin and brown, acute or muticous, a little shorter than the perigynium. (276a.) California, Silver Valley, head of Toulumne River, and Ebbett's Pass, *Brewer* 1969, 1774, 2020, 2079, Soda Springs, Nevada County, *M. E. Jones*, San Bernardino Mts., *Parish*. The greater size, broad culm and leaves, thick head, firmer perigynia, duller color, and other characters remove the species from *C. Liddoni*, its nearest relative. Var. *incerta* of the latter species, however, may belong to *C. specifica* rather than to *C. Liddoni*.

31.—CAREX STRAMINEA, Willd. in litt.* in Schk., Riedgr. 49, f. 34 (1801) v. s. Hb. Willd.

C. straminea, var. *minor*, Dewey, Sill. Journ. (I.) xi. 158 (1826).

C. festucacea, var. *tenera*, Carey, Gray's Man. 1st ed. 545 (1848).

C. tenera, Sartw. Exsicc. No. 45 (1848), v. s.; Olney, Exsicc. fasc. ii. No. 13 (1871), v. s.

C. straminea, var. *tenera*, Boott, Ill. 120, t. 384 (1862).

C. tenera, Dew., forma *erecta*, Olney, Exsicc. fasc. ii. No. 14 (1871), v. s.

*Willdenow should in like manner be cited as authority for *C. Norvegica*.

C. straminea—"a slender woods form"—Bailey, Herb. distrib. (1886).

Culm slender, often very thin, the leaves lax; head open and slender, from three-fourths inch to two inches long, mostly inclined or somewhat drooping, the axis often weak or zigzag; spikes small, often scattered (sometimes a half inch apart); perigynium small and comparatively narrow, often long-pointed. This weak plant is the *Carex straminea* originally described and figured by Schkuhr. In the second part of his Riedgraser, five years later, he figured the stout and stiff plant which commonly has been regarded as the type of the species. This plant is

Var. BREVIOR, Dewey, Sill. Journ. (I.) xi. 158 (1826).

C. festucacea, Willd. Sp. Pl. iv. 242 (1805), v. s.

C. straminea, Schk., Riedgr. Nachtr. 23 f. 174 (1806).

C. straminea, var. *Schkuhrii*, Gay, Ann. Sci. Nat. (II.) x. 363 (1838), v. s.

C. straminea, var. *festucacea*, Tuckm., Enum. Meth. 18 (1843); Boott, Ill., 1200, t. 386 (1862).

C. straminea typica, and vars. *Crawei* and *Meadii*, Boott, Ill. 121 tt. 387, 388, 389 (1862), v. s.

C. fœnea, var. *β* Boott, Ill. 118, t. 376 (1862).

C. fœnea, var ? *ferruginea*, Gray, Man. 5th ed. 580 (1867).

C. straminea, vars. *hyalina* and *typica*, Gray l. c.

C. tenera, var. *suberecta*, Olney, Exsicc. fasc. ii. No. 16 (1871), v. s.

Culm stiff, longer than the erect and long-pointed stiff leaves; head usually short and erect; spikes three to eight, globose or ovoid, usually contiguous, large; perigynium broad. The old *C. festucacea*, Willd., although bearing a long and open head, belongs here rather than to the type on account of its stiff habit and large spikes.

Var. HYALINA, Boott, Ill. iii. p. iv. (1862).

C. hyalina, Boott, Journ. Boston Nat. Hist. Soc. v. 112 (1845), v. s. Hb. Boott.; Ill. t. 371, f. 2 (1862.)

NOTE.—*C. straminea*, var. *festucacea*, Gay, Ann. Sci. Nat. (II). x. 363 (1838), v. s. Hb. Kew., is founded upon two plants, *C. straminea* var. *mirabilis*, Tuckm., and *C. fœnea*, Willd. (*C. adusta* of authors.)

C. straminea, var. *intermedia*, Gay, l. c. v. s. Hb. Kew., is also mixed, part being *C. straminea*, var. *brevior*, Dewey, and part *C. silicea* Olney.

C. tetrastachys, Scheele, Linnæa, xxii. 374 (1849).

Very tall and slender (16 inches or more high); spikes much contracted below, medium in size; perigynium very thin, flat and scale-like, the wide nerved margin wrinkled or corrugated above, produced into a very long and slender beak which renders the spikes comose in appearance; scales small and inconspicuous. Florida, *Chapman*, westward to Texas.

✓ Var. CUMULATA.

C. alata, Torr., var. *pulchra*, Olney, at least in part, Exsicc. fasc. ii. No. 23 (1871), v. s.

Culm very tall and stiff; spikes several to many (sometimes 25!) greenish, usually aggregated into a bunchy head, very densely flowered and squarely contracted at the base, short and pointed, spreading; perigynium appressed, the points therefore not conspicuous. Monroe Co., Penn., *Porter*, to New Brunswick, *Fowler*; also on the Saskatchewan Plains, *Macoun*. Most like the var. *alata*, Bailey. In its heavier forms it resembles *C. tribuloides*, Wahl.

Var. AUSTRALIS.

C. pinetorum, Liebm., Mex. Halv. 75 (1850), v. s. Hb. Liebm.

C. festiva, forma *humilis*, Bœckl. Engler's Bot. Jahr. i. 75 (1881), v. s. (Excl. syn. *C. propinqua*, Nees et Meyer.)

Low (3 to eight inches high), the culm more or less curved; head small, composed of about three small and distinct but contiguous ovate spikes; perigynium small, the margin narrow, nerveless or nearly so, greenish or very light-tawny. Real del Monte, Mexico, *Coulter* 1622 (type, Hb. Kew.); Orizaba, *Liebmann*. This is the nearest approach of *Carex straminea* to *C. festiva*. From the latter species it is certainly distinguished by its separate and ovate spikes, the characters of the perigynium, and general port. *C. propinqua*, Nees (v. s. Hb. Berol.) I have never seen from North America. I doubt if it belongs to *C. festiva*.

Carex straminea may be better understood by adopting the following arrangement:

A.—*Heads stramineous.*

Carex straminea, Willd.

Var. brevior, Dewey.

Var. hyalina, Boott.

Var. australis, Bailey.

Var. mirabilis, Tuckm. (Sometimes greenish).

Var. aperta, Boott.

Var. maxima, Bailey.

Var. invisa, W. Boott.

B.—*Heads usually greenish.*

Var. alata, Bailey.

Var. cumulata, Bailey.

Var. fœnea, Torr.

Var. mixta, Bailey.

This arrangement omits two of the catalogued varieties, as they appear to merit specific distinction:

32.—CAREX SILICEA, Olney, Proc. Amer. Acad. Arts and Sci. vii. 393 (1868), v. s; Exsicc. fasc. i. No. 13 (1871).

C. straminea, var. *moniliformis*, Tuckm. Enum. Meth. 17 (1843); Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 151 (1886).

The essential characters of this plant appear to be constant, and its strictly maritime habitat gives it an additional value.

33.—CAREX STRAMINIFORMIS.

C. straminea, var. *congesta*, Boott, v. s.; Olney, Proc. Amer. Acad. Arts and Sci. vii. 393 (1868); Exsicc. fasc. ii. No. 20 (1871), v. s.

Aside from the dense head, in which the individuality of the spikes is more or less lost, and various minor characters, this plant differs from *C. straminea* as follows: Root dense and tough; lower portion of the culm clothed with many loose and leafless dry sheaths; leaves more numerous, much broader, thick and coriaceous, apparently nearly evergreen; lowest spike subtended by a broad and short scale-like bract; perigynium nerveless or nearly so, conspicuously margined, light colored and much broader than the lance-ovate, brown and sharp-pointed scale. (282a). California, Oregon and Washington.

34.—CAREX ADUSTA, Boott, Hook. Fl. Bor.-Am. ii. 214 (1840); Ill. t. 379.

C. albolutescens, Schw., var. *glomerata*, Olney, Exsicc. fasc. v. No. 10 (1871), v. s.

C. adusta, var. *glomerata*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 149 (1886).

C. pinguis, Bailey, Bull. 3, Geol. and Nat. Hist. Surv. Minn. 22 (1887.)

Culm very stiff and stout (1 ½ to 3 ft. high), longer than the leaves; head dense and broad, strictly erect, of which at least the lowest spike is subtended by a short and very broad-based, nerved and pointed bract; spikes globose, never prominently narrowed below; perigynium short-ovate and very plump, nearly filled by the large achenium, nearly or quite marginless, the inner face flat or not conspicuously convex and nerveless or very nearly so, the outer face very lightly nerved. In dense tufts: Mt. Desert, Maine, *Greenleaf*, New Brunswick, *Fowler*, Crawford Co., Michigan, *Bailey*, N. Minnesota, *Bailey*, and northwestward. Rare in the United States.

Carex adusta and *C. fœnea*, Willd., are admirable illustrations of the confusion into which some of our Carices have fallen. Boott founded his *C. adusta* upon specimens from Cumberland House, British America, and afterwards confounded with it the plant of our Northeastern States which has passed for this species. In restoring Boott's name to its original signification, the *Carex adusta* of all botanies and floras must change its name, and here *C. fœnea* of Willdenow comes forward to add new perplexities:

35.—Carex fœnea, Willd. Enum. Pl. Hort. Berol. 957 (1809), v. s. Hb. Willd. and Hb. Berol. (not authors).

C. argyrantha, Tuckm. in Herb. distr. (1859), v. s. Hb. Gray.; Boott. Ill. t. 382, f. 2.

C. adusta of authors in part.

C. albolutescens, Schw. var. *argyrantha*, Olney, Exsicc. fasc. i. No. 9 (1871).

C. adusta, var. *argyrantha*, Bailey, Carex Cat. (1884).

Culm slender and often weak, (1 to 2 ft. high); head long and weak, often nodding; spikes five to eight, small and silvery-green, much contracted below and alternately disposed; perigynium varying from ovate to long-ovate, thin, much longer than the small achenium, prominently rough-margined, strongly many–nerved on both sides; bracts entirely wanting or very in-

conspicuous. New England and Pennsylvania, and westward to Michigan and Minnesota.

The species, as I have drawn it, includes larger forms than those described either by Willdenow or Tuckerman Willdenow's specimens, particularly, are weak and short-headed, but as they were from cultivated plants they cannot be regarded as wholly representative of the species. The specimens of *C. fœnea* in Willdenow's herbarium are immature, but the characters are evident. Moreover, among the specimens of *C. ovalis*, in Willdenow's collection, is a sheet of the same, the specimens being more developed. This sheet is evidently from the same plants as the original; in fact, in the general herbarium at Berlin this plant is again mixed with "*C. ovalis*," and as *C. ovalis* was cultivated in the gardens at that time (*vide* Enum. Pl. Hort. Berol.), it is apparent that the original *C. fœnea* was mixed with it in culture. It is evident, therefore, that the specimens lying with *C. ovalis*, both in Willdenow's herbarium and in the general collection, are duplicates of the type. These duplicates are important, for they are mostly mature, although they differ in no other respect from Willdenow's type specimens. The same plant is again in the general herbarium, from Link, ticketed "*C. fœnea*, H. B." ("Hort. Berol.").* When Dr. Gray examined the plants of Willdenow, *Carex adusta* had not been separated from *C. straminea*, and it is not strange that he did not fully comprehend the plant in question. The plant understood as *C. fœnea* by Torrey and by him referred to *C. straminea* (v. s. Hb. Torr.), is wholly distinct from the plant of Willdenow, and Torrey's *C. straminea* var. *fœnea* may, therefore, stand. Bœckeler appears to have been the first to separate the plant of Willdenow from that of Torrey. (Linnæa, xxxix. 117 (1875)), but he refers it to his fourth form of *C. straminea.*

Willdenow's specimens are ambiguous' but I cannot identify them with any other species. The thin and almost translucent perigynia are characteristic of the American plant.

---

*There is also a plant in the general herbarium, from Kunth, which is labelled *C. fœnea* and certified to by Wahlenberg, but it is evidently a scoparia-like form of *C. straminea.*

Var. PERPLEXA.

C. adusta, Boott, Ill. 119, mostly, tt. 380 and 382 in part (1862), v. s. Hb. Boott, and authors largely, except Boott in Hook. Fl. Bor.-Am.

C. albolutescens, Olney, Exsicc. fasc. i. No. 8 (1871), v. s. (not Schw).

C. albolutescens, var. *sparsiflora*, Olney, Exsicc. fasc. v. No. 11, (1871), v. s.

C. adusta, var. *sparsiflora*, Bailey, Carex Cat. (1884).

Mostly taller and stouter than the species, the spikes larger and less attenuated or even truncate below, more approximate or even aggregated, the head erect or nearly so and the lowest bract sometimes prominent. New England to Northern Minnesota.

36.—CAREX CRYPTOCARPA, Meyer, Mem. Acad. St. Petersb. i. 226 t. 14 (1831).

C. Scouleri, Torr. Monogr. 399 (1836), v. s. Hb. Torr.

C. filipendula, Drejer, var. *concolor*, Drejer, Rev. Crit. Car. Bor. 46 (1841), v. s. Hb. Havn., Fl. Dan. t. 2372.

C. Romanzoviana, Chamisso. Steud. Plant. Cyper. 216 (1855), v. s. Hb. Lenorm.

This puzzling species extends from Northern Europe, through Greenland, and probably entirely across boreal North America, into Eastern Asia. The plants described under *C. filipendula* by Drejer, have not heretofore been carefully collated with the forms of *C. cryptocarpa*. I propose with confidence the following disposition:

Var. PUMILA.

C. filipendula, Drejer, var. *variegata*, Drejer, l. c. v. s. Hb. Havn.; Fl. Dan. t. 2371 (fig. not characteristic).

Low (6 to 12 in. high); pistillate spikes commonly two, short (¾ in. or less), ovate or short-oblong; scales broad and muticous, but little longer than the much lighter colored perigynium. Norway, *Fries*; Iceland; near Victoria, B. C., *Macoun*, and Alaska, *Krause*.

Var. HÆMATOLEPIS.

C. hæmatolepis, Drejer, l. c. 44, v. s. Hb. Havn.

Drejer himself compared this plant with his *C. filipendula*, and his characters of separation, which the material now accumulated shows to be only of varietal value, may still be quoted:

"spikes sub-erect, lax-flowered, elongated, peduncles often shorter and stronger, scales shorter, culm rough." The scales are longer than the perigynium, but obtuse or muticous, and the spikes are usually darker colored than in the species. Greenland, and probably adjacent America.

37.—CAREX FLAVA, L. Sp. Pl. i. 975 (1753), v. s. Hb. Linn.

C. foliosa, Gaud. Agr. Helv. ii. 191 *teste* Koch.

C. uetliaca, Sut. Helv. ii. 251, *teste* Koch.

C. flava, forma *lepidocarpa* and *androgyna*, Olney, Exsicc. fasc. iii. Nos. 26 and 27 (1871), v. s.

As compared with its varieties, *C. flava* is distinguished by its sessile or nearly sessile staminate spike, the contiguous and sessile pistillate spikes, the large, long-beaked, and much reflexed perigynium, the broad and abruptly divaricate bract, the broad and flat leaves, and the conspicuous yellow color of the whole plant. Europe, North America.

The various forms of this perplexing species have been singularly misunderstood and confounded. This is particularly true of the var. *Œderi*, the name having been transferred in recent years to a plant very different from the one originally characterized. A prolonged and careful study of the species in many herbaria discloses the fact that the American forms differ from the European, and enables me to present, with considerable confidence, the following arrangement:

Var. ELATIOR, Schlecht. Fl. Berol. i. 477 (1823), v. s. Hb. Berol.

C. flava, Host, Gram. Austr. i. 48, t. 63, f. 4, v. t.

C. lepidocarpa, Tausch, Flora, 1834, 129.

C. Lipsiensis, Peterm. Fl. Lips. 58 (1838), v. s. Hb. Berol.

C. pyriformis, F. Schultz, Jahr. xv. 122, *teste* F. Schultz.

C. flava, var. *lepidocarpa*, Anderss. Cyp. Scand. 25 (1849), and many authors since.

C. Marssoni, Auerswald, Bot. Zeit. 1852, 409.

C. flava, var. *Marssoni*, Marsson, Fl. Neu-Vorp. 537 (1869).

Staminate spike long-peduncled, pistillate spikes scattered or remote and commonly not more than two and the lowest one usually peduncled, perigynium smaller, straight or but slightly

bent, bracts and leaves narrow, and the color dull green throughout, tall and slender, (1 to 2 ft.). Europe. In America, represented by

Var. RECTEROSTRATA, Bailey, Bot. Gaz. xiii. 84 (1888).

Staminate spike sessile or nearly so, pistillate spikes three to four, of which the two or three uppermost are sessile and contiguous or approximate, the lowest being somewhat remote and more or less peduncled, spikes looser-flowered then in var. *elatior*, perigynium shorter then in the species and straight or nearly so, bracts long and spreading, but narrow, the lowest sheathing, leaves narrow, whole plant green, tall. Vancouver Island, *Macoun*.

Var. ŒDERI, Liljeblad, Svensk. Fl. 1st. ed. (1792).

C. divisa, Œder, Fl. Dan. fasc. vii. 4, t. 371 (1768).

C. Œderi, Ehrh.* Calam. Exsicc. No. 79 (1790 ?); Willd. Mem. Acad. Roy. 1794, 44, t. 1, f. 2; Schkuhr, Riedgr. 67, t. Ff. 26 (1801).

C. patula, Host, Gram. Austr. i. 48, t. 64, f. 1 and *C. Œderi*, Host, l. c. 49, t. 65, f. 1. v. t.

C. Œderi, Eng. Bot. t. 1773 (1801), v. t.

C. flava, var. *flavescens*, Wahl. Act. Holm. xxiv. 150 (1803).

C. flava, var. Willd. Sp. Pl. iv. 269 (1805).

C. flava, *β*. Schkuhr, Riedgr. Nacht. 56 (1806).

C. flava, var. *lutescens*, Wahl. Fl. Lapp. 234 (1812), v. s. Hb. Wahl.

C. flava, var. *Œderi*, Schlecht. Fl. Berol. 477 (1823), and many authors since.

C. Œderi, vars. *œdocarpa*, *elatior* and *pygmæa* Anderss. Cyp. Scand. 25 (1849).

C. flava, forma *depressa*, F. Schultz, Herb. Norm. Exsicc. cent. x. No. 955 bis. v. s.

C. Eu-flava, var. *lepidocarpa*, Syme, Eng. Bot. ed. iii. x. 159, t. 1673 (1870), v. t.

C. flava, vars. *pumila* and *intermedia*, Coss. et Germ. Fl. Paris, Ed. i.

---

*Ehrhart cites Retz as authority for the species, but Retz declares that his plant is not the plant of Ehrhart (Kongl. Vet. Acad. Handl. xiv. 314. Stockholm, 1793). See also Lilj. Svensk., and Schk. Riedgr.

C. flava, var. *patula*, Coss. et Germ. Fl. Paris, Ed. iii.

C. flava, var. *minor*, Towns. Journ. Bot. xix. 161, v. s.; Bailey, Bot. Gaz. xiii. 84 (1888).

Staminate spike usually short-stalked, or a very small pistillate spike at its base, pistillate spikes green, scattered, some of them often radical, the lower ones peduncled, all densely flowered, perigynium small, rounded below, beak shorter than the body, straight or nearly so, bracts comparatively broad and long, spreading, leaves broad for the size of the plant which is low (3 to 8 in.) and diffuse, and green in color. Europe, generally distributed, and Atco, New Jersey, *Martindale*, introduced. Often confounded with var. *elatior*. This is not the plant which commonly passes for var. *Œderi* (see var. *cyperoides*), but it is certainly the one so understood by the older botanists. I have not been able to find Ehrhart's specimens, but the figure of Œder's *C. divisa*, which is the starting-point of var. *Œderi* and which is regarded by the Danish botanists as this plant (teste Lange, Nomen. Fl. Dan. pp. 12 and 279 (1887)), is unequivocal, as is also Willdenow's excellent figure. (Mem. Acad. Roy. 1794). Schkuhr's figure is less characteristic, but is, nevertheless, clearly this plant. An excellent illustration of the transfer of the name to another plant is afforded by the English Botany. Its figure of *C. Œderi* in 1801, is the plant under discussion, but its figure so named in 1870 is var. *cyperoides*. Represented in America by

Var. GRAMINIS.

Staminate spike short and sessile, pistillate spikes green, two or three and contiguous, globular or short-oblong, sessile, perigynium long-pointed but straight or nearly so, the beak often rough, the bract leafy and usually divaricate, leaves comparatively broad, the plant low (4 to 10 in. high), erect, green. In grassy places, probably generally distributed in the Northeastern States. A dwarfed and green form of the species, and is probably common. Specimens from Scotland closely resemble this but several characters appear to separate them.

Var. CYPEROIDES, Marsson, Fl. Neu-Vorpommern, 537 (1869), v. s.

C. chrysites, Link, Hb. Berol. v. s.

C. Œderi, Syme, Eng. Bot. ed. iii. x. 157, t. 1674 (1870), v. t., and most European botanists.

Staminate spike very small and short, closely sessile, pistillate spikes short (usually a half inch or less long) or globular, narrow, closely sessile and agglomerate at the top of the culm (or rarely one remote or radical), perigynium very small and short-beaked (half or less the size of the foregoing varieties), straight or nearly so, yellow or golden in color when mature, the bracts long and mostly erect and involucre-like from the agglomerate position of the spikes (whence the appropriate varietal name), the leaves narrow and erect, plant low (3 to 8 in. high), and yellowish. Europe; from Portugal, *Link*, to England and Sweden, *Andersson*. In America, represented by

Var. VIRIDULA.

C. viridula, Michx. Fl. Bor.-Am. ii. 170 (1803), v. s. Hb. Michx.; Boott, Ill. t. 523 (1867); Olney, Exsicc. fasc. i., No. 27 (1871), v. s.

C. irregularis, Schw. An. Tab. (1823), *teste* Dewey.

C. Œderi, Schw. and Torr. Monogr. 334 (1825); Dewey, Sill. Journ. x. 38 (1826); Gray, Gram. and Cyp. Exsicc. ii. No. 166, (1834), v. s.; Sartw. Exsicc. No. 124 (1848), v. s., and all American authors.

Differs from the last, among other characters, by its greater height (often a foot or more high), larger and longer spikes, and much longer and usually stricter bracts, and usually the much duller color of the spikes. Newfoundland to Pennsylvania and westward to Montana, *Williams* and S. Utah, *Parry*. Usually appears distinct from the species, but its relationship to var. *cyperoides* is very close and that variety clearly belongs to *C. flava*.

38—CAREX LAXIFLORA, Lam. Dict. de Bot. iii. 392 (1789), v. s. Hb. Lam.

C. heterosperma, Wahl. Köngl. Acad. Handl. xxiv. 151, (1803), v. s.

C. anceps, Muhl.; Willd. Sp. Pl. iv. 278 (1805), v. s. Hb. Willd.; Schk. Riedgr. Nachtr. 66, f. 128, (1806), v. s. Hb. Schk.

C. nematostachya, Willd.; Schlecht. Linnæa, x. 264 (1836), v. s. Hb. Willd.

C. nematosperma, Kunth, Enum. Pl. ii. 456 (1837).

C. anceps, var. *angustifolia* Dew. Wood's Bot. 1845, 423.

C. gracilescens, Steud. Cyp. Plant. 226 (1856), v. s. Hb Steud.

C. laxiflora, vars. *intermedia* and *blanda gracillima*, Boott, Ill. 37, 38, t. 91 (1858).

Lamarck's specimens, both from Virginia and New York, although young, are unmistakably the plant which Boott made var. *intermedia*, and I therefore revise the species that this form may appear as the type. The specimens of *C. anceps*, both in the collection of Willdenow and Schkuhr, are mixed.

The type of *C. laxiflora* embraces slender plants, characterized by narrow leaves (usually less than ¼ in. in width), a peduncled or at least very conspicuous staminate spike, scattered pistillate spikes which are very loosely flowered and narrow (½ to 1½ in. long), and very blunt perigynia. Var. *striatula* is marked by broad leaves, a very short and inconspicuous sessile staminate spike, very short and thick pistillate spikes (rarely over ½ in. long), the upper ones being sessile about the staminate spike, and the lower exserted on very slender peduncles. Between these two plants are perplexing forms which bear some characters in common, and which may be designated as

Var. VARIANS.

C. laxiflora, var. *intermedia*, Bailey, Bull. 3, Minn. Nat. Hist. & Geol. Surv. 22 (1887), not Boott.

Leaves broad (¼ to ½ in. wide); staminate spike sessile or nearly so; pistillate spikes cylindrical (½ in. to 1 in. long), two or three of them contiguous to the staminate spike and sessile or nearly so, one or two remote and short peduncled; bracts leafy and prolonged. New Hampshire to New Jersey, Minnesota and Kansas.

Var MICHAUXII.

C. striatula, Michx. Fl. Bor.-Am. ii. 173 (1803) v. s. Hb. Michx.

C. ignota, Dewey; Sartw. Exsicc. No. 97 (1848), v. s. Sill; Journ. (II). viii. 348 (1849).

C. laxiflora, Boott. Ill. t. 89 (1858).

Usually rather tall and slender; leaves narrow for the species; staminate spike commonly long-peduncled; pistillate spikes scattered, the lowest slenderly peduncled, loosely flowered, short (an

inch or less long); perigynium long-pointed and but slightly curved, triquetrous, finely many nerved, much longer and broader than the acute or muticous very thin scale. Carolina and southward, and westward to Texas.

Var. DIVARICATA.

Differs from the type in its larger and more or less clavate and peduncled staminate spike, the long and large (an inch or more long) pistillate spikes, which are scattered, the lower ones being remote and very long-peduncled, and particularly by the very large and divaricate trigonous and long-pointed perigynium which is contracted into a stipe-like base half or more as long as the body. Plant tall; leaves rather narrow; bracts moderately broad, three to five inches long. Near Washington, D. C., *Vasey.*

The following names belong to *C. laxiflora*:

C. truncata, Bœckl. Flora, 1858, 649, v. s. Hb. Carey. and Hb. Kew. (Drummond's 423), = *C. laxiflora.*

The scales are white-hyaline, truncate and awned, but I find no other characters to separate this from ordinary forms of the species. The characters of the scales are variable in this plant. I have the same plant from Louisiana.

C. bulbosa, Bœckl. Flora, 1855, 597, v. s. Hb. Kew., is the var. *Michauxii.* The species was described upon an unnumbered specimen collected by Drummond. The specimen in Hb. Kew., although unnamed, answers so completely the description that I have no hesitation in taking it for a dulicate of Bœckeler's original; it is from Drummond. In his later writings, Bœckeler has not mentioned this species.

C. fusiformis, Chapm.; Dew. Sill. Journ. (II). vi. 244 (1848), v. s. Hb. Carey., is a large-spiked var. *styloflexa*, Boott.

C. Chapmanni, Steud. Cyp. Plant. 222 (1856), is founded upon Chapman's *C. fusiformis*, and therefore is var. *styloflexa.*

39—CAREX DEBILIS, Michx. Fl. Bor.-Am. ii. 172 (1803), v. s. Hb. Michx.

C. debilis, var. *y*, Boott, Ill. 92, t. 274 (1860).

C. debilis, var. *prolixa*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 105 (1886).

Michaux does not state in his Flora, where he obtained his

C. debilis. His specimens are labelled "Basse Carolina ?" The sheet contains, aside from this species, specimens of *C. laxiflora* var. *striatula*, Carey and *C. prasina*, Wahl. His description was drawn from the species in question.

Var RUDGEI.

C. tenuis, Rudge, Linn. Trans. vii. 97 t. 9 (1804), v. s. Hb. Kens.

C. flexuosa, Muhl.; Willd. Sp. Pl. iv. 297 (1805); Schk. Riedgr. Nachtr. 74 f. 124 (1806).

C. debilis, authors; Boott, Ill. t. 272.

The common Northern form.

Var. STRICTIOR.

Usually taller, strict; leaves broader (about 2 lines wide) and firmer; spikes stiffer, simply spreading or even erect; perigynium mostly shorter, and the scale often nearly as long as the perigynium. White Mountains, *Faxon.*

40—CAREX STRIATA, Michx. Fl. Bor.-Am. ii. 174 (1803), v. s. Hb. Michx.; Boott, Ill. t. 151 (1858).

Michaux had the Southern form, with hairy perigynia. Carolina to Florida.

Var BREVIS.

C. striata, *β*, Boott, Ill. 57 (1858).

Bracts shorter; perigynium smooth and usually more abruptly beaked; scales less sharp. North Carolina to New Jersey.

41—CAREX TRICEPS, Michx. Fl. Bor.-Am. ii. 170 (1803), v. s. Hb. Michx.

C. viridula, Schw. and Torr. Monogr. 320 (1825) v. s. Hb. Schw.

C. Bolliana, Bœckl. Flora, 1878, 40, *teste* Bœckl. in litt.

Small and slender (6 to 12 in. high); leaves smooth or rarely sparsely hairy below; sheaths hairy or puberulent; spikes small (a half inch or less long), contiguous and sessile; perigynium narrowly ovate or cylindrical-obovate, ascending; pistillate scale white-hyaline, the midnerve extended into a short and often hispid awn; staminate scales white-hyaline and sharp. Carolina to Texas.

Var. SMITHII, Porter; Bailey, Bot. Gaz. xiii. 88 (1888).

C. Caroliniana, Schw. Ann. N. Y. Lyc. Nat. Hist. i. 67 (1824) v. s. Hb. Schw.

C. Smithii, Porter; Olney, Exsicc. fasc i. No. 28 (1871) v. s.

Usually taller, olive-green; leaves smooth throughout; sheaths hirsute or puberulent; spikes longer, more scattered, the lower one or two usually short-peduncled; perigynium globular or nearly so, somewhat turgid, divaricate; scales, both pistillate and staminate, more obtuse and browner. The squarrose and fat perigynia give the spikes a peculiarly dense aspect which at once distinguishes this plant. Pennsylvania and New Jersey to N. Carolina; Arkansas, *Hasse*.

Var HIRSUTA.

C. hirsuta, Willd. Sp. Pl. iv. 252 (1805); Schk. f. 172 (1806) v. s. Hb. Schk.

C. triceps, Boott, Ill. t. 128 (1858).

A stouter and taller plant, as a rule, than either the type or the previous variety, green; leaves conspicuously hirsute; spikes usually larger and scales longer and sharper. The common northern form.

42—CAREX MILIARIS, Michx. Fl. Bor.-Am. ii. 174 (1803), v. s. Hb. Michx; Boott, Ill. t. 200, f. 2 (1858); Olney, Exsicc. fasc. 1, No. 16 (1871), v. s.

C. saxatilis, L. var. *miliaris*, Bailey, Bot. Gaz. ix. 120 (1884).

This puzzling species has been poorly defined, largely because two or three different plants have been confounded. It was for this reason that I was led to refer it to *Carex saxatilis*, with which it has no immediate affinity. The material is yet scant, but three forms of the plant appear to be clearly defined, and a fourth one is referred here provisionally. Whatever future observers may decide as to the merits of the varieties I propose, the disposition suggested cannot fail to make the species better known.

Culm very slender but erect (12 to 18 in. high), smooth or slightly rough above on the angles; leaves narrow, often almost filiform, rough on the edges, mostly shorter than the culm; staminate spikes one or two, elevated an inch or more from the upper pistillate spike, very narrow, an inch or less long; pistillate spikes one to three, the upper one sessile and the lower very short-stalked, small (¾ in. or less long), the lowest subtended by a bract which usually exceeds it; perigynium very small, broadly

or round-ovate, or ovate-oblong, thin but firm in texture, bearing a nerve upon either angle but otherwise nerveless or sometimes bearing a few very faint nerves near the base, rounded into a very short and terete beak which is either entire or somewhat erose; pistillate scales brown, lance-ovate, ending in a sharp whitish tip which nearly or quite equals the perigynium. Richibucto and Lake Mistassin, Canada, *Michaux;* Island in the Saguenay, near Lake St. John, Lower Canada, *A. H. Smith;* Rothsay, New Brunswick, *Fowler;* Drury's Cove, St. John's, N. B. *Hb. Gray.;* Newfoundland, *La Pylaie* (*Hb. Gray.*); outlet of Moosehead Lake, Maine, *C. E. & A. H. Smith.*

Very young specimens from Kennebeckasis, N. B., coll. by Fowler and distributed by Olney (Exsicc. fasc. v. No. 18) as "form. *minor*," cannot be determined, but they do not appear to belong here. The specimens distributed under this number were mixed. (See var. *obtusa*).

Var. OBTUSA.

Culm mostly shorter and even more slender; pistillate spikes much smaller (from ⅓ in. long to smaller and globular), closely sessile; pistillate scale very obtuse, little, if any more than half the length of the perigynium. Marguerite River, Lower Canada, *A. H. Smith.* In my own collection, Olney's No. 18 of fasc. v, from Kennebeckasis, N. B., *Fowler,* contains one specimen of this variety. This is evidently an admixture from Smith's collection, as Olney had Smith's plants. In Herb. Gray. this admixture does not occur in Olney's set.

Var. MAJOR.

C. miliaris, var., Olney. Exsicc. v. No. 16 (1871), v. s.

Much stouter (often fully two feet high), the culm thick and very sharply angled; leaves stout and canaliculate or involute; staminate spikes short-stalked; pistillate spikes one to five, mostly short-oblong, but often cylindrical (varying from ⅓ in. to 1½ in. long), stout and very dark and dull brown, the lower one or two short-peduncled; scale varying from wholly obtuse to muticous. Jupiter River, Anticosti, 1883, *Macoun;* Ungava Bay, N. Labrador, 1884, *Turner*; Outlet of Moosehead Lake, *Porter.* This plant lacks entirely the slender and graceful habit of *C. miliaris*, but I can detect no other constant characters of separation.

Var. ? AUREA.

C. pulla, Gray, Man. 5th ed. 602 (1867), v. s.

C. pulla, var. (?) *miliaris*, Gray, l. c., v. s.

C. miliaris, var., Olney, Exsicc. fasc. v. No. 17 (1871), v. s. and No. 18, probably.

Taller and mostly stouter than the species; staminate spikes two to three, mostly long-peduncled; pistillate spikes one or two, the upper sessile, the lower short-peduncled, often staminate at the apex, yellow or stramineous; perigynium thin and yellow as in *C. monile*, mostly prominently few-nerved, gradually produced into a conspicuous and more or less toothed beak, broader and usually longer than the light brown or whitish muticous scale. Kennebeckasis, N. B., *Fowler*; Outlet of Moosehead Lake, Maine, *C. E. & A. H. Smith*. This plant, in the color of its spikes and characters of its perigynia, at once suggests *C. monile*, with which future study may unite it. So far as can be determined from the poor material at hand, it lacks entirely the peculiar texture of the small and abruptly short-beaked perigynia of *C. miliaris*.

A plant collected at the outlet of Moosehead Lake by C. E. Smith, and referred doubtfully to *C. rotundata*, Wahl. in the Manual, I am unable to place, although it may be an outlying form of this poorly defined variety. The beak is exceedingly short and perfectly entire.

43—CAREX PHYSOCARPA, Presl. Reliq. Hænk. i. 205 (1830), v. s. Hb. Presl.; Boott Ill. t. 513 (1867), v. s. Hb. Boott; Bailey. Proc. Amer. Acad. Arts and Sci. xxii. 65 (1886).

C. ochroleuca, Chamisso; Steud. Plant. Cyper. 216 (1855), v. s. Hb. Lenorm.

Distinguished by its rough-peduncled and comparatively short (an inch or two) brown spikes, its very broad and obtuse scale, and the short and nerveless, short and entire-beaked perigynium, which exceeds the scale. Nootka Sound, *Hænke*; Rocky Mts. of British America, *Drummond*, *Macoun*; Alaska, *Chamisso*. This is a puzzling species. Macoun's specimens, collected at Morley, have scales more inclined to be acute than do other specimens, but I have no hesitation in referring them to this species.

44—CAREX SAXATILIS, Linn. Fl. Lapp. 259.

C. pulla, Gooden. Linn. Trans. iii. 78 (1797), v. s. Hb. Kew.

I am entirely unable to draw close lines of separation between

the various forms of *C. saxatilis*, *C. vesicaria* and *C. monile* ; and no doubt C. *physocarpa* will be found to add confusion to the group. After much study in many places, the arrangement of C. *saxatilis* proposed in my Synopsis still seems the best for our present purpose. The characters of C. *saxatilis* may be drawn as as follows:

A low plant (4 to 8 in. high), the culm often curved, with one staminate spike, and one or two short (seldom over a half inch long and usually shorter) and dark purple pistillate spikes which are either sessile or short-peduncled ; perigynium nearly orbicular, very short and entire-beaked and nerveless. Scotland and Northern Europe, Greenland and Behring Straits and James Bay, *J. M. Macoun*. Its nearest ally is *C. compacta*, which differs at once as follows: Culm very strict and stout and conspicuously longer than the usually broader leaves, a foot or more high; staminate spikes often two; pistillate spikes longer and evenly cylindrical, very compact; lower bract conspicuously spreading.

Var GRAHAMI, Hooker & Arnott, Brit. Fl. 8th ed. 510.

C. Grahami, Boott, Linn. Trans. xix. 215 (1843), v. s. Hb. Boott.

C. saxatilis, var. *major*, Olney, Bot. King's Rep. v. 370 (1871).

Larger; staminate spikes often two; pistillate spikes two to three, heavier and longer, the lowest usually long-peduncled; perigynium less purple or even entirely yellow, much more slender and longer beaked, nerved; scales sharper. Scotland; high mountains of Colorado, Utah, and northward. It is possible that future observers may be able to detect varietal differences between the plants of Scotland and America. The larger forms of the American plant differ considerably from the Scottish, but there are all possible gradations between them. Var. *Grahami* runs close to forms of *C. monile*, from which it is distinguished by its short and entire beak, much less prominently nerved perigynium, more obtuse scales, and smaller size.

The following matters of synonymy may be corrected in this connection:

C. hymenocarpa, Drejer, Revis. Crit. Car. Bor. 58 (1841), v. s. Hb. Havn., is not *C. compacta*, R. Br., but a boreal form of *C. rostrata*, Stokes. (*C. rostrata* var. *hymenocarpa*,

Christ, Comptes-Rend. Soc. Roy. Bot. xxiv. part 2, 11 (1885),).

C. vesicaria, var. *alpigena*, Fries, Mant. ii. 142, v. s., is not to be referred to *C. saxatilis.* It is highly probable that both this and *C. hymenocarpa* are forms of *C. rostrata*, Stokes, as Lange maintains.

C. vesicaria, var. *dichroa*, Anderss. Cyp. Scand. 18 (1849), is evidently also a form of *C. rostrata.*

C. ampullacea, var. *borealis*, Lange, Fl. Grœn. ii. 118, v. s. Hb. Havn., is not *C. compacta*, but is perhaps inseparable from the preceding plants.

The removal of these names from *C. compacta* (*C. membranacea*, Hook. is *C. compacta*, v. s. Hb. Kew.) removes the species from Greenland and renders its characters distinct. At the same time, a study of good material indicates that *C. rotundata*, Wahl. (v. s. Hb. Wahl), occurs in America only in Greenland. It is merely a reduced form of *C. rostrata*, Stokes, and need never be confounded with *C. compacta.*

45.—Carex monile, Tuckm., is distinguished from all the preceding species by its long and slim spikes which are yellow, its turgid, large, strongly nerved perigynium, which is produced into a long and sharply toothed beak, its narrow and sharp scales, and greater size. The var. *obtusisquamis*, Bailey, is anomalous, and its position is provisional.

Var. Raeana.

C. Raeana, Boott, Rich. Arc. Exped. ii. 344 (1851), v. s. Hb. Boott; Ill. 25, t. 64 (1858).

Distinguished by its smaller size, much shorter (1½ in. or less long) and thinner spikes, and particularly by the very narrow and involute leaves. Methye Portage, British America, *Richardson.*

Var. colorata.

Smaller; spikes shorter than in the species, dark brown; perigynium very much less turgid and shorter beaked; scales shorter and not so sharp. Colorado: Grand Lake, *Vasey*, 5,849; Leadville, *Trelease.* I have not the specimens referred to *C. monile* by Wm. Boott in Bot. Cal. ii. 251 (*Bolander* 6,211), but I suspect that they belong to this variety. Transition to *C. saxatilis* var. *Grahami.*

Var. MONSTROSA.

Terminal spike more or less pistillate ; pistillate spikes reduced to one or two, very small and loosely flowered, and usually on very long and filiform peduncles ; whole plant very slender. —Concord River, E. Massachusetts, *Swan*, growing with *C. oligosperma*, Michx.

46.—CAREX AMBUSTA, Boott, Ill. 64, t. 172 (1858), v. s. Hb. Boott; Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 88 (1886).

C. salina, var. *ambusta*, Bailey, Carex Cat. (1884).

This is a good species, to be separated from *C. saxatilis*, its nearest ally, by the characters which have been already pointed out : Perigynium nearly lanceolate, gradually long-pointed and spreading, possessing none of that shiny, papery and inflated appearance so characteristic of most of the Vesicariæ ; scales much longer and acute or muticous ; lower spike on a short but slender peduncle. Ungava Bay, Labrador, *Turner ;* British Columbia, *Rothrock*, to Alaska.

47.—CAREX VARIA, Muhl. in Wahl. Kongl. Acad. Handl. xxiv. 159 (1803) ; Willd. Sp. Pl. iv. 259 (1805), v. s. Hb. Willd.; Schkuhr. Riedgr. Nachtr. 48, f. 167 (1806), v. s. Hb. Schk.

C. alpestris, Dewey, Sill. Journ. (I.) vii. 268 (1824).

C. Davisii, Dewey, l. c. x. 279 (1826).

C. albicans, Willd. in Herb.; Spreng. Syst. Veg. iii. 818 (1826); Schlecht. Linnæa, x. 264 (1836), v. s. Hb. Willd.

C. Emmonsii, Dewey ; Torr. Monogr. 411 (1836) ; Sartw. Exsicc. No. 105 (1848), v. s.; Boott, Ill. 97, t. 286 (1860).

C. Novæ-Angliæ, var. *Emmonsii*, Carey, Gray's Man. 1848, 556.

C. lucorum, var. *Emmonsii*, Chapm. Flora S. States, 539 (1860).

C. Emmonsii, var. *elliptica*, Boott, Ill. 97, t. 287 (1860).

It is singular that modern botanists have overlooked the fact that Schkuhr's figure of *Carex varia* is the *C. Emmonsii* of Dewey. This species was sent to Europe by Muhlenberg under a MS. name, and the specimens were divided among Wahlenberg, Willdenow and Schkuhr. These specimens are unmistakably the plant defined by Dewey as *Carex Emmonsii*.

Var. COLORATA.

Scales conspicuously purple-margined, giving the head a dark appearance.—Chiefly southward, evidently, and not common. In a species which is characterized by green heads, such a variation appears to be worth a varietal name.

The *C. varia* of all later botanists may be called

48.—CAREX COMMUNIS.

C. varia, Dewey, Sill. Journ. 1st ser. 152 (1826); Sartw. Exsicc. No. 108 (1848), v. s.; Boott, Ill. 97, t. 288 (1860), and all authors since Muhlenberg.

C. varia, var. *pedicillata*, Dewey, l. c. 163, (1826); Sartw. l. c. No. 109, v. s.

C. Pennsylvanica, Gray, Gram. and Cyp. Exsicc. ii. No. 162 (1834), v. s.; Torr. Monogr. 410 (1836).

C. Pennsylvanica, var. *Muhlenbergii*, Gray, l. c. No. 163, v. s.

C. varia, var *minor*, Boott, Ill. 97, t. 389 (1860).

Canada to Georgia.

Var. WHEELERI.

Mostly lower than the species; leaves very numerous, very broad and bright green, conspicuously shorter than the culm; staminate spike very short (usually only a fourth or third inch long), closely sessile, inclined and inconspicuous; lowest bract leaf-like, often an inch or two long. Knolls in woods: Cheshire Co., N. Hampshire, *Bailey*; Ionia Co., Michigan, *Wheeler*, and Alcona Co., *Bailey*. In aspect much like *C. varia* (*C. Emmonsii*), but is at once distinguished by the broad leaves and large perigynia.

C. collecta, Dewey, referred to this species by Boott, is *C. Novæ-Angliæ*, Schw.

C. turbinata, Liebm. Mex. Halv. 77 (1850), v. s. Hb. Liebm., referred to this species by Bœckeler (Engler's Bot. Jahrb. i. 364), is a good species, distinguished, among other things, by its strongly many-ribbed perigynia. Future observers may find that my *C. rigens* is a large, stiff, and more developed form of *C. turbinata*. (See No. 94).

49.—CAREX DEFLEXA, Hornemann, Plantelære, Ed. 3, i. 938 (1821); v. s. spec. authent. Hb. Gray.

C. varia, var. *minor*, Boott, Hook. Fl. Bor.-Am. ii. 223 (1840), in part.

C. pilulifera, var. *deflexa*, Drej. Rev. Crit. Car. Bor. 54 (1841).
C. Novæ-Angliæ, authors in part.

Very low, much tufted; culms from 1 to 6 inches long, setaceous, more or less curved or spreading, little exceeding or shorter than the narrow leaves; staminate spike exceedingly minute and nearly always invisible in the head; pistillate spikes two or three, two to five flowered, green or green-and-brown, all aggregated into a little head, the lowest one always more or less short-peduncled and subtended by a leafy bract a half inch or less long; radical spikes very few or none; perigynium very small, much contracted below, sparsely hairy or nearly smooth, the flat beak exceedingly short. Rocks and woods, Greenland, southward to the high mountains of New Hampshire and Vermont, and westward to Alaska, and E. Oregon, *Cusick*, and the Wenatchie region of Washington, *Brandegee*, 1145. A neat little alpine Carex. Its particular distinguishing marks are the lower leafy bract and the peduncled lowest spike, although this peduncle is often so short as to be concealed by the bract. Excellent characters are also found in the staminate spike and in the disposition of the pistillate spikes. It is the boreal representative of *C. varia*, Muhl. (*C. Emmonsii*, Dew). Like most alpine species, it runs into many forms in intermediate localities, but the material is now sufficient to warrant the following positive disposition:

Var. DEANEI.

C. varia, var. *minor*, Boott, Hook. Fl. Bor.-Am. ii. 223 (1840), in part.

C. Novæ-Angliæ, authors, in part; Boott, Ill. t. 285 (1860).

Taller and laxer, the culms from 6 to 12 inches high and some or all prominently exceeding the long and loose soft leaves; staminate spike much larger (2 to 3 lines long), erect or oblique, strictly sessile; pistillate spikes larger (four- to eight-flowered), less aggregated or the lowest usually separated, though rarely more than ¼ inch removed; radical spikes usually numerous; bract mostly longer. Swales or dryish places, subalpine regions of New Hampshire, Vermont, New York, and northward, and Mt. Desert, Me. In aspect like *C. varia*, Muhl. (*C. Emmonsii*, Dew). Named for Walter Deane, of Cambridge, Mass., an ardent student of the New England flora.

Var. MEDIA.

C. Novæ-Angliæ, var. *deflexa*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 124 (1886).

Rather stiff, 4 to 12 inches high, in dense tufts; most of the culms somewhat exceeding the leaves; staminate spike prominent and erect, 3 to 5 lines long, sessile or very short-peduncled; pistilate spikes two or three, all scattered, the uppermost at or near the base of the staminate spike, the lowest usually very prominently peduncled and subtended by a conspicuous bract which surpasses the culm, all rather compactly three- to eight-flowered, green or brown-and-green; radical spikes usually abundant; perigynium much as in short-beaked forms of *C. umbellata*; scales large and sharp, equalling or exceeding the perigynium. Mountains, Montana and Colorado to Oregon. In aspect much like tall forms of *C. umbellata*, Schk.

Var. ROSSII.

C. Rossii, Boott, Hook. Fl. Bor.-Am. ii. 222 (1840).

C. Novæ-Angliæ, var. *Rossii*, Bailey, Bot. Gaz. x. 207 (1885).

Stiff throughout, very strict, the leaves mostly equalling or exceeding the culms, the whole plant usually light colored; staminate spike much as in the last, often larger; pistillate spikes one to three, distinct or sometimes scattered, loosely one- to four-flowered; radical spikes usually abundant; scales very sharp, greenish-white or very rarely bearing an inconspicuous colored margin. Mountains, Colorado to British Columbia.

Var. BOOTTII.

C. brevipes, W. Boott, Bot. Calif. ii. 246 (1880), in part at least.

C. globosa, var. *brevipes*, W. Boott, l. c. 485.

Low and more or less diffuse (6 inches or less in height), some at least of the culms somewhat exceeding the leaves, which are broader and flatter than in any other form of the species; staminate spike short and sessile or nearly so; pistillate spikes one or two, contiguous, large and compact (four- to twelve-flowered), the lowest subtended by a very broad bract which mostly much surpasses the culm; radical spikes abundant; scales broadly purple-margined. Mountains, California.

50.—CAREX NOVÆ-ANGLIÆ, Schw. Ann. N. Y. Lyc. Nat. Hist. i. 67 (1824), v. s. Hb. Schw.; Dewey, Sill. Journ. (I.) ix. 64, t. 2, f. 7 (1825); Schw. & Torr. Monogr. 328 (1825).

C. collecta, Dewey, Sill. Journ. (I.) xi. 314, f. 44 (1826), v. s. Hb. Gray. and Hb. Schw., and *teste* Torr. Monogr. 411, and Dewey, Cat. Pl. Mass. 266.

Very slender, stoloniferous, the culms 6 to 8 inches high, about the length of the very narrow and loose leaves; staminate spike always distinct, erect and prominent, 3 to 8 lines long, mostly minutely peduncled, exceedingly narrow (about ½ inch broad); pistillate spikes usually two, the upper near the base of the staminate spike, the lower from ½ to 1 inch removed and short stalked and subtended by a bract which nearly or quite equals the culm, both rather loosely three to six-flowered; radical spikes none; perigynium very narrow, often nearly oblanceolate, very thinly hairy, the sharp beak prominent; stigmas often two. W. Massachusetts: Saddle Mountain, 3,000 feet altitude (the original locality), "small bogs on the border of a high sphagnous marsh, Worthington, Mass., with *C. curta*," *Dewey*; Mt. Desert, Me., *Rand;* St. John's, New Brunswick, *Fowler;* "In grassy woods," Prince Edward Island, *Macoun*. Very rare. In aspect much like depauperate forms of *C. Pennsylvanica*.

51.—CAREX BARBARÆ, Dewey, Bot. Mex. Bound. Surv. 231 (1859), v. s. Hb. Olney.; Sill. Journ. (II). xxxi. 24 (1861).

C. Schottii, Dewey, l. c. v. s. Hb. Olney., evidently.

C. aquatilis, W. Boott, Bot. Cal. ii. 241 (1880), v. s. Hb. Gray.

Sufficient material has now accumulated to allow of a positive characterization of this species: Tall and leafy, glaucous; culm sharply angled and rough, particularly above; pistillate spikes two to four, long and narrow (1 to 3 in. long), the upper one or two sessile or short peduncled and often staminate at the apex, the lower very long and slenderly peduncled (peduncle 3 to 4 in. long), very much attenuated at the base, usually truncate at the top; bracts leaf-like, the lowest one or two much prolonged; perigynium small, obovate or ovate, nerveless, abruptly contracted into a short and small, but very distinct beak, either

shorter or longer than the white-backed and brown-edged obtuse or muticous scale. California; Santa Barbara, *Parry*, Los Angeles, *Wood*, San Jose, *Bolander*. Oregon; *Wilkes* 308, Mt. Hood, *Howell*, Lost Lake, *Henderson* 1,689. Washington; Skamania County, *Suksdorf* 107. Vancouver Island, *Lyall*, *Macoun* 25, (1887). This species is closely allied to *C. aquatilis*, Wahl., and it should stand next that species (72 *a*). The place now occupied by *C. Barbaræ* in my Synopsis (No. 86), should be filled by

52.—CAREX HOWELLII.

Tall and stout (3 to 6 ft. high); culm very sharply angled, rough above; leaves broad and lax and very long, the sheaths covering the base of the culm with a long and papery brown envelope; staminate spikes two to three, heavy, prominently peduncled; pistillate spikes about four, very long (2 to 4 inches), cernuous or somewhat bent, the upper two on peduncles a half inch or inch long, and usually staminate above, the lowest very long peduncled (peduncle sometimes six inches long); perigynium narrowly elliptic or elliptic-oblong, obscurely few-nerved, conspicuously granulated when mature, produced into a slender and entire beak, shorter than the lance-linear, muticous, dull brown scale.—Oregon: swamps at the mouth of the Columbia, *Howell*. The gross habit, aside from more particular characters, separate this at once from *C. Barbaræ*.

53.—CAREX MACOUNII, A. Bennett; Macoun, Cat. Can. Pl. iv. 147 (1888), v. s.

C. salina, var.? *robusta*, Bailey, Bot. Gaz. xiii. 87 (1888).

I proposed this plant as a variety of *Carex salina* from the impression that it might prove to be a hybrid, inasmuch as the perigynia in the specimens are empty, and the plant appears to be variable. It is evident, however, that *Carex salina* does not occur on the western side of the continent, and that the plant in question is a good species.

54.—CAREX SALINA, Wahl. Köngl. Acad. Handl. xxiv. 165 (1803), v. s. Hb. Wahl.

C. salina, var. *mutica*, Wahl. Fl. Lapp. 246 (1812), v. s. Hb. Wahl.; Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 88 (1886).

C. lanceata, Dewey, Sill. Journ. (I.) xxix. 249 (1836).

C. salina, var. *minor*, Boott, in part, Ill. 160, tt. 527 and 528 (1867).

Cumberland House, British America, to Greenland. N. Europe.

Var. CUSPIDATA, Wahl. Fl. Lapp. 246 (1812).

C. cuspidata, Wahl. Kongl. Acad. Handl. xxiv. 164 (1803), v. s. Hb. Wahl.

C. stricta, Hook. and Arn. Bot. Beechey's Voy. 131 (1834).

C. recta, Boott, Hook. Fl. Bor.-Am. ii. 220. t. 222 (1840).

Hudson's Bay to Massachusetts. Europe.

In proposing this arrangement of the synonymy of *Carex salina*, Wahlenberg's original application of the name is adopted. He described at the same time (1803) *C. salina* and *C. cuspidata*; afterwards (1812) he united them into a composite species, making them varieties of a *C. salina* for which he designated no typical form, a practice still common among European botanists in the treatment of variable species. When later botanists insisted upon separating one of the varieties to represent the type of *Carex salina*, the var. *cuspidata* was chosen, leaving the plant which had been originally proposed as *C. salina* to rank as a variety.

55.—CAREX TOLMIEI, Boott. Hook. Fl. Bor.-Am. ii. 124 (1840), v. s. Hb. Boott.; Ill. 100 t. 299 (1860.)

C. vulgaris, var. *alpina*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 81 (1886), mostly.

This ambiguous species appears to include a great number of forms, and to represent *Carex vulgaris* on the western side of our continent. The true var. *alpina*, Boott (*C. rigida*, Good.) is a short and stiff plant with narrow leaves, broad perigynia and short, obtuse scales; it occurs in our high latitudes, ranging from Greenland to Behring Straits, and evidently extending as far south as Cumberland House. The plants of the western mountains of the United States, formerly referred to this variety, may be to associated for the present with *C. Tolmiei.*

Plant rather stout, from a dense and woody root (1 to 2 feet high); leaves very broad for the group, deep green, conspicuously pointed, shorter than the culm; staminate spike usually one, mostly short-peduncled; pistillate spikes two to four, somewhat contiguous or partially scattered, oval or oblong (½ to 1½ inches

long), the two lowest usually on slender peduncles an inch or two long, the others sessile or nearly so; lowest bract leaf-like and equalling or exceeding the culm; perigynium compressed-trigonous, ovate or round-ovate in outline, pale and more or less discolored or even covered with purple dots (or rarely almost yellow), produced into a very short and entire beak, mostly shorter than the obtuse or muticous purple scale; stigmas two or three. Mountains of Oregon and Washington to Montana.

Var. NIGELLA.

C. nigella, Boott, Hook. H. Bor.-Am. ii. 225 (1840), v. s. Hb. Boott.; Ill. 194 (1867).

Perigynium minutely bidentate; scale narrower and sharper. Columbia River, *Tolmie;* Mt. Hood, *Henderson.*

Var. SUBSESSILIS.

Spikes short and thick (from round oblong to an inch long), very densely flowered, the staminate sessile, the pistillate aggregated near the top of the culm, sessile, or the lowest very short peduncled; perigynium broader and more abruptly contracted. E. Oregon, *Cusick* 1,178 and 1,180; Gray's Peak, Colorado, *Patterson.*

Var. ANGUSTA.

Taller; leaves very long and narrow, the basal sheaths becoming fibrillose; spikes all sessile, or the lowest peduncled, cylindrical; bracts narrow, or filiform. Kerbyville, Oregon, *Howell.* Probably a distinct species.

56.—CAREX LAXICULMIS, Schweinitz, Ann. N. Y. Lyc. Nat. Hist. i. 70 (1824), v. s. Hb. Schw.

C. retrocurva, Dewey, Wood's Bot. 1845, 423.

Canada to Carolina. Distinguished by its glaucousness.

Var. FLORIDANA.

Lower (6 to 10 inches high), the leaves but one-third or one-fourth the width of those in the type; upper spike contiguous to the staminate spike, and sessile or short peduncled. Florida, *Chapman, Curtiss.*

57.—CAREX DIGITALIS, Willd., var. COPULATA.

C. retrocurva, var. *copulata*, Bailey, Herb. Distr. 1886.

Larger than the species, the culms weak and reclining, sometimes two feet long; leaves twice or thrice broader; spikes

shorter and heavier; perigynium mostly larger.—Woods, central Michigan, where it is common. In aspect much like *C. laxiculmis*, but has no glaucousness, the upper spikes are shorter peduncled, and minor characters also separate them. I find it to be connected with *C. digitalis* by intermediate forms.

58.—CAREX PTYCHOCARPA, Steudel, Pl. Cyper. 234 (1855), v. s. Hb. Boott. (Drummond, 424); Bœckl. Linnæa, xli. 147 (1877); Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 116 (1886).

Low, the culm two to five inches high, and a half or less shorter than the glaucous leaves, which are ¼ inch or less wide; staminate spike small and sessile and usuually overtopped by the upper pistillate spike; pistillate spikes lax-flowered, the upper sessile, and only the lowest long-peduncled; bracts leafy, broad and elongated. Purgatory Swamp, near Boston, *Faxon*, *Morong*; New Jersey, *Britton*; Delaware, *Canby*; Florida, *Chapman*, *Curtiss*; New Orleans, *Drummond*.

Var. MACROPHYLLA.

C. digitalis, var. *glauca*, Chapm. Flora, S. States, 541 (1860), v. s. Hb. Torr.

Leaves very broad (⅓ in. or more), two to three times longer than the culm (1 to 1½ ft. long), prominently many-nerved and very glaucous. Florida, *Chapman*. A singular plant.

59.—CAREX JAMESII, Schweinitz, Ann. N. Y. Lyc. Nat. Hist. i. 67 (1824), v. s. Hb. Schw.

C. Steudelii, Kunth, Enum Pl. ii. 480 (1837), v. s. Hb. Berol.

When Schweinitz proposed this species, *C. Steudelii* had not been separated from *C. Willdenovii*, and Schweinitz and Torrey a year later referred this species to *C. Willdenovii*. Torrey's *C. Jamesii* must now take another name:

60.—CAREX NEBRASKENSIS, Dewey, Sill. Journ. (II.), xviii. 102 (1854), v. s. Hb. Torr.

C. Jamesii, var. *Nebraskensis*, Bailey, Carex Cat. Suppl. (1884).

√ Var. PRÆVIA.

C. Jamesii, Torr. Mongr. 398 (1836).

Distinguished from the species chiefly by its longer and sharper scales and more ascending pergynia.

61.—CAREX CRINITA, Lam., var. MINOR, Boott, Ill. 18 (1858).

C. crinita, var., Sartw. Exsicc. No. 78 (1848), v. s.

Much smaller than the type (2 ft. or less high), the leaves half narrower; spikes small and short (1 ¼ in. or less long); scale shorter and smoother. Penn Yan. N. Y., *Sartwell*; Mt. Desert, Me., *Redfield*. Has somewhat the aspect of *C. prasina*, Wahl.

√ 62.—CAREX VICARIA.

C. glomerata, Bœckel. in part, Linnæa, xxxix. 59 (1875); W. Boott, Bot. Cal. ii. 232 (1880), v. s. Hb. Gray.

C. Brongniartii, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 137 (1886).

The Pacific slope representative of *C. vulpinoidea*, Michx.: Spikes looser-flowered than in that species, the perigynium much larger and more spreading, somewhat stipitate, nerveless, or bearing indistinct short nerves on the inner face, striated with brown nerves on the back, the bracts wanting except the one or two lower ones, which are setaceous and somewhat prolonged (½ to 1½ in. long). Oregon and California. I have examined the original of *C. Brongniartii*, Kunth (v. s. Hb. Berol.) and find that it is distinguished from the North American plant by several characters, particularly by the much broader perigynium which is prominently nerved inside. In fact, *C. Brongniartii* is closely alllied to *C. Muhlenbergii*, Schk. Other plants, variously named, from various parts of South America, approach more nearly our plant, but it is impossible definitely to refer our species to any South American species; and I am confident that future observation will discover other permanent characters of separation, inasmuch as such has been the case in nearly every instance in which Carices of the two countries, which were supposed to be identical, have been carefully studied.

√ Var. COSTATA.

Perigynium very strongly many-nerved or ribbed on the outer face, and usually bearing three or four nerves on the inner face. Grant's Pass, Oregon, *Henderson*, 1477.

MISSOURI
BOTANICAL
GARDEN.

✓ 63.—Carex densa.

C. Brongniartii, Boott, t. 402 (1862).

C. paniculata, W. Boott, Bot. Cal. ii. 232 (1880), v. s. Hb. Gray.

C. Brongniartii, var. *densa*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 137 (1886).

Head very dense, ovoid or nearly globose in general outline, dull dark brown; lowest bract often conspicuous, setaceous, an inch or so long; perigynium broad-lanceolate, twice longer than in the last species, thick, very strongly nerved on both sides, wingless or slightly rough-margined above, produced into a long, cylindrical cleft beak; scales muticous or short-acute. California: *Palmer, Bigelow, Brewer, Kellogg* and *Harford* 1067.

C. Xalapensis, Kunth, referred here in my Synopsis, is *C. Muhlenbergii*, Schk. var. *enervis*, Boott (v. s. Hb. Berol.).

C. glomerata, Thunb., a South African species, is separated from both *C. densa* and *C. vicaria* by several characters, chiefly by the broader and flatter perigynium which is less nerved, conspicuously margined, laciniate on the edges above, and shining at maturity.

✓ 64.—Carex alma.

Allied to *C. vulpinoidea*, Michx. and *C. vicaria*, Bailey: Culm short and stiff (a foot to foot and a half high), sharply angled, roughish, often curved; leaves very stiff, canaliculate, rather broad, longer than the culm, glaucous; spikes mostly compound, very numerous and composing a head three to four inches long, the lower ones sometimes remote, but mostly densely aggregated, dull brown; bracts broad, with thin white margins, produced into an awn which does not equal the spike; perigynium ovate, small and thin, margined, nerveless or nearly so, very rough on the margins above, the beak bifid; scales broadly ovate, prominently white-margined, acute (242*a*). San Bernardino Co., California, *Parry* and *Lemmon* 396 (Hb. Bailey., and Hb. Phila. Acad. Sci.). In aspect much like *C. leiorhyncha*, Meyer, but distinguished at once by the absence of the setaceous bracts and by the rough-angled perigynium. It is probable that all the plants referred to *C. leiorhyncha* in this country belong to this species.

65.—CAREX TRIANGULARIS, Bœckl. Flora, 1856, 226; Linnæa, xxxix. 96 (1875).

C. vulpinoidea, var., Boott, Ill. t. 409, f. 2 (1862).

C. vulpinoidea, var. *platycarpa*, Olney, Hall's Pl. Tex. 25 (1873), v. s.; Bailey, Coulter's Man. 392 (1885).

C. vulpinoidea, var. *Drummondiana*, Bœckl. Linnæa, xxxix. 96 (1875), v. s. Hb. Berol.

More slender than *C. vulpinoidea*, but strict; spikes fewer, strictly simple, more or less scattered, green or light brown, truncate at the top; bracts few and usually inconspicuous or wanting above the lowest; perigynium larger than in *C. vulpinoidea*, very broad, prominently spreading, nerved and usually minutely dotted. Indian Territory to Louisiana and Texas.

√ 66.—CAREX FESTIVA, Dewey, var. STRICTA.

Culm long and rather stiff (2 to 2½ ft.), exceeding the leaves; leaves stiff and the lower ones short, as in *C. straminea*; head very dense, globular or short-ovoid, light brown (¾ to 1 in. long); perigynium broad, more or less nerved. California, *Palmer* 389, *Kellogg* and *Harford* 1073; Buck Creek, Oregon, *Howell* 938. Aside from the congested head, this plant has the appearance of *C. straminea*.

√ Var. VIRIDIS.

Culm very long and lax (3 ft. or more); leaves shorter than the culm but loose and lax; head very dense, globular or nearly so; perigynium very thin, green, broader and twice longer than the brown muticous scale and therefore giving the head a green appearance. Montana: 16 mile Creek, *Scribner* 315; Park Co., *Tweedy*. Perhaps a good species.

√ Var. PACHYSTACHYA.

C. pachystachya, Chamisso; Steud. Plant. Cyp. 197 (1855), v. s. Hb. Lenorm.

Culm more or less prolonged (1 to 3 ft.), flat and weak, longer than the lax leaves; head small, globular or oblong, dull dark brown, the spikes often somewhat distinct, very short; perigynium spreading, about the length of or somewhat longer than the ovate-lanceolate muticous brown scale. Park Co., Montana, *Tweedy*; Portland, Oregon, *Henderson*; Alaska, *Chamisso*.

67.—CAREX PRESLII, Steud. Plant. Cyp. 242 (1855).

C. leporina, Presl, Reliq. Hænk. 204 (1830); Bailey, Coulter's Man. 396 (1885).

C. leporina, var. *Americana*, Olney, Proc. Amer. Acad. Arts and Sci. viii. 407 (1872), v. s.

The American plant is specifically distinct from *C. leporina*, L. Steudel founded his *C. Preslii* upon the description of Presl's *C. leporina*. The orginal does not exist, either in the collection of Presl or Steudel, but I adopt Steudel's name in lieu of any other. *C. petasata*, Dewey, Sill. Journ, (I). xxix. 246 (1836), referred here by Boott, cannot be pressed into service. The original sheet is in Herb. Torr. It contains three plants: *C. lagopina*, Wahl., *C. festiva*, Dewey, and *C. Liddoni*, Boott, to all of which Dewey's description will equally apply.

68.—CAREX APERTA, Boott, Hook. Fl. Bor.-Am. ii. 218, t. 219 (1840), v. s. Hb. Boott.

C. acuta, var. *prolixa*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 86 (1886).

The confusion into which Boott's *Carex aperta* has fallen is explained in Bot. Gaz. xiii. 84 (1888), and the opinion there expressed that the species is confined to our northwestern coast is verified by an examination of Boott's material. The plant referred to *C. aperta* in the Eastern States is *C. stricta*, var. *decora*, Bailey, l. c. 85.

69.—CAREX ACUTINA.

C. acuta, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 86 (1886).

A fine suite of specimens of *Carex acuta* given me by Arthur Bennett, Croydon, England, and a study of the species in various foreign herbaria, have enabled me to draw lines of separation between the European plant and the western plants which have been referred to it. *C. acutina* differs from *C. acuta* in the pale color of the plant and its lesser size and thin leaves, habitually smaller spikes, thinner and shorter perigynium, which is much less prominently nerved, and the lighter colored obtuse or muticous scales. Oregon, *Howell* 935, *Henderson;* British Columbia, *Dawson.*

The *C. acuta* credited to Greenland by Drejer (Rev. Crit. Car. Bor. 13, No. 31), and cited by myself (Proc. Amer. Acad. l. c.), is *C. vulgaris*, var. *hyperborea*, Boott (v. s. Hb. Havn. and *teste* Lange).

Var. TENUIOR.

Tall but more slender; leaves narrower; spikes shorter (an inch or less long) and narrow, more scattered; perigynium smaller. Oregon, "margins of lakes," *Howell;* Washington, in water on sub-alpine slopes of Mt. Adams, *Henderson* 1489.

70.—CAREX TETANICA, Schk., var. WOODII.

C. Woodii, Dewey, Sill. Journ. (II.) ii. 249 (1846); Sartw. Exsicc. No. 79 (1848), v. s.

C. panicea, var. *Woodii*, Olney, Exsicc. fasc. ii. No. 27 (1821), v. s.

C. tetanica, "a slender form," Bailey, Herb. Distr. 1886.

Very slender, often tall (1 to 2½ ft.), widely spreading by slender runners; spikes very slender, alternately flowered. Woods, New York and Michigan and south to Washington.

Var. CANBYI, Porter, Car. Penn. 9, in Proc. Phila. Acad. Nat. Sci. 1887.

C. panicea, var. *Canbyi*, Olney, Exsicc. fasc. ii. Nos. 24 and 25 (1871), v. s.

Usually stouter than var. *Meadii*, Bailey, the leaves broader and flatter (2 lines wide); spikes usually heavier; perigynium larger, the point scarcely bent; scale larger, nearly as long as or longer than the perigynium, acute or muticous. Delaware Co., Penn., *Canby;* Illinois, *E. Hall.* Olney's labels of his No. 24 bear both the above localities and I am not certain as to which locality my specimens are from. I have the same plant from Lapham, labelled, "prairies," probably from Illinois.

C. tetanica, var. *Carteri*, Porter, l. c., is var. *Meadii*, Bailey, v. s. and *teste* Porter.

71.—CAREX TERETIUSCULA, Gooden., var. AMPLA.

Very large and stout, growing three feet or more high in dense tufts; heads large (2 to 3 in. long), much branched, chaffy; perigynium twice larger than in the species, nerved on the back, shining at maturity, produced into a long beak. Quaking bogs, head of Burnt River, E. Oregon, *Cusick* 1331, near Salem, *Howell.*

72.—CAREX PSEUDO-CYPERUS, var. AMERICANA, Hochst. Herb. Unio Itin. (1837), v. s. Hb. Berol.

C. furcata, Ell. Sk. Bot. Car. ii. 552.

C. Pseudo-Cyperus, Schw. and Torr. Monogr. 335 (1825).

C. comosa, Boott, Linn. Trans. xx. 117 (1846), v. s. Hb. Boott.

C. Pseudo-Cyperus, var. *comosa*, W. Boott, Bot. Cal. ii. 252 (1880).

✓ 73.—CAREX HYSTRICINA, Muhl., var. DUDLEYI.

C. Pseudo-Cyperus × *C. hystricina ?* Dudley, Cayuga Fl. 118 (1886), v. s. Hb. Cornell.

Usually taller than the species; spikes longer and slimmer (1½ to 2½ in. long), light-colored, all prominently spreading or nodding on one side of the culm; perigynium more ascending, somewhat deeper-toothed, yellower at maturity; scale longer, and prominent. Wethersfield, Conn., *Wright;* near Ithaca, N. Y., *Dudley;* Wisconsin? *Lapham.* The spikes have much the general aspect of *C. Schweinitzii*, Dewey.

74.—CAREX GRAYII, Carey, var. HISPIDULA, Gray in herb.

Perigynium evenly but sparsely hispid. As this is the only instance in which a member of the Section Physocarpæ has hairy perigynia, it seems worth while to recognize the variety.

✓ 75.—CAREX PARRYANA, Dewey, var UNICA.

C. Hallii, Hayden's Rep. 1871, 496, v. s. Hb. Gray.

Spike single and terminal, or sometimes attended by a small or rudimentary one; perigynium usually broader and more conspicuously beaked; scales larger. Pleasant Valley, Idaho, *Hayden.* Evidently diœcious.

76.—CAREX TRIBULOIDES, Wahl. Köngl. Acad. Handl. xxiv. 145 (1803); Fl. Lapp. 250 (1812).

C. lagopodioides, Schk. Riedgr. Nachtr. 20, f. 177 (1806), v. s. Hb. Schk.; Sartw. Exsicc. No. 42 (1848), v. s.; Boott, Ill. t. 370 (1862).

C. scoparia, var *lagopodioides*, Torr. Monogr. 394 (1836).

C. lagopodiodes, var. *composita*, Olney, Exsicc fasc. ii. No. 10 (1871), v. s., and forma *glomerata*, l. c. fasc. i. No. 6, v.s.

This species is a tall and stiff plant, usually three feet or more high, with a stout head of long and ascending green spikes. I

was unable to find Wahlenberg's original, but it was probably the same collection as Schkuhr had, as Wahlenberg appears to have obtained many of his American plants through Willdenow and Schkuhr. Schkuhr's fig. 177 cannot pass for any other species than the one under consideration, however, and Wahlenberg says (Fl. Lapp. 250) that his species is the same as this figure.

In order to properly understand *C. tribuloides*, it is necessary to throw its variations into two series, as follows:

I.—Heads green or greenish.

Var. CRISTATA, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 148 (1886).

C. cristata, Schw. Ann. N. Y. Lyc. Nat. Hist. 66 (1824), v. s. Hb. Schw.; Boott, Ill. t. 372 (1862).

C. straminea, var. *cristata*, Tuckm. Enum. Meth. 18 (1843).

C. lagopodioides, var. *cristata*, Carey, Gray's Man. 1848, 545; Olney, Exsic. fasc. i. No. 7 (1871), v. s.

Tall and stout; head stout and erect, more or less continuous, composed of several to many globular dense spikes; perigynium long-pointed and spreading, giving the spikes a cristate appearance. Pennsylvania to New England and westward to Iowa.

✓ Var. TURBATA.

C. tribuloides, Herb. Unio Itin. No. 204 (1837), v. s. Hb. Berol.

C. lagopodioides, var., Boott, Ill. t. 371, f. 1 (1862).

Plant slender and lax; head an inch or two long, loose, slender, mostly greener than in the last; spikes obovate-oblong (¼ to rarely ½ inch long), contracted below, the lower ones usually distinct or even alternate, becoming tawny, if at all, only when the perigynia begin to fall; perigynium ascending, the points not conspicuous. Shady copses and woods, Massachusetts to Michigan and southward to Alabama, *Mohr*, and S. Louisiana, *Langlois*. Evidently not common.

II. Heads tawny or brown.

✓ Var. BEBBII.

C. Bebbii, Olney, Exsicc. fasc. ii. No. 12 (1871), v. s.

Head dense, ovoid or oblong, short (¼ to ¾ inch long, or rarely an inch), the lower spike only rarely distinct; spikes small

(¼ inch or less in length), their axes ascending; bracts at the base of the head small, or none. Dry low grounds; generally distributed in the Northern States as far west as Dakota and Nebraska. Ordinarily included in var. *cristata.*

Var. REDUCTA, Bailey, l. c.

C. scoparia, var. *moniliformis,* Tuckm. Enum. Meth. 17 (1843).

C. cristata, Boott, Ill. t. 373 (1862).

C. lagopodioides, var. *moniliformis,* Olney, Exsicc. fasc. ii. No. 8 (1821), v.s.; Bailey, Bot. Gaz. x. 380.

Culm slender, especially above, surpassing the long-pointed and lax leaves; spikes two to ten, small, nearly globular or somewhat contracted below (three lines or less in diameter), all distinct, the lowest alternate; perigynium conspicuously spreading. Connecticut to New Brunswick, and west to Minnesota.

77.—CAREX GRISEA, Wahl., var. (?) RIGIDA.

Whole plant rigid; leaves narrow, about the length of the culm; staminate spike an inch long, mostly peduncled; pistillate spikes two or three, widely scattered, peduncled, or the upper sessile, an inch or less long, loosely flowered; perigynium long-elliptic, prominently trigonous, not turgid, finely striate, distichously arranged, longer than the broad-based and prominently awned scale. Sellersville, Pennsylvania, *Fretz;* Faulkland, Delaware, *Commons;* Florida, *Chapman.* A singular plant, which I do not understand. Chapman's plant, which Dr. Boott referred to *C. grisea,* var *angustifolia,* is the least characteristic of the three.

78.—CAREX FILIFORMIS, L., var. AUSTRALIS.

Spikes commonly thicker than in the type; perigynium oblong or elliptic, usually twice, or nearly so, as long; scales much longer and strongly acuminate. Central Europe: common. The Scandinavian plant, which Linnæus described, appears to be the same as the American.

79.—CAREX DONNELL-SMITHII.

One of the *Polystachyæ,* standing next to *C. melanosperma,* Liebm.: Plant tall and stout (3 feet high), the lower sheaths purple and becoming shreddy; leaves as long as the culm, rather stiff, roughish on the margins; spikes twenty or more, one to three inches long, rather loosely flowered,

the staminate portion about half an inch long; main bract leafy and very much prolonged (a foot or more in length); perigynium lanceolate in outline, not trigonous, divaricate and much bent, provided with two or three prominent ribs and a few intermediate nerves, produced into a slender and sharply short-toothed beak about half the length of the body and somewhat rough on the margins; all the scales conspicuously lacerate-awned, those of the staminate portion more or less appressed, the pistillate divaricate and about the length of the perigynium. (107*a*). Pansamalá, Department of Alta Verapaz, Guatemala, altitude 3,800 feet, *H. von Türckheim*, 659; communicated by John Donnell Smith. The plant is abnormal in one respect, the top of the culm being fasciated, rendering the head of spikes very short and compact. The perigynia, however, and particularly the awned and lacerate staminate and pistillate scales, designate it from all other species with which I am acquainted. The perigynium of *C. melanosperma* is smaller, straighter, and much shorter-beaked, the beak entire or oblique, and is less prominently nerved (See No 94).

80.—CAREX ROSEA, Schkuhr, var. RETROFLEXA, Torr. Monogr. 389 (1836).

C. retroflexa, Muhl. Willd. Sp. Pl. iv. 235 (1805), v. s. Hb. Willd.; Boott, Ill. t. 226 (1860).

C. bicostata, Olney, Exsicc. fasc. iv. No. 17 (1871) v. s.

New England to Pennsylvania and westward through New York.

Var. TEXENSIS, Torr. Monogr. 389 (1836).

Var. *retroflexa*, authors, in part.

More slender than the last; perigynium very narrow, usually narrowly lanceolate, longer beaked than in the last, much more conspicuously spreading or reflexed. Mt. Carmel, S. Illinois, *Schneck*, and from Alabama to Texas.

81.—CAREX ECHINATA, Murray, Prodr. Stirp. Gotting. 76. (1770.)

The type of this species does not occur in the Eastern United States so far as I can determine. Specimens from the Pacific slope appear to be the same as the European plant, yet more material is needed to warrant a definite reference. American varieties of this species may be defined as follows:

Var. CEPHALANTHA.

Rather stiff but slender, 1 to 2 feet high; leaves very narrow and involute, about the length of the culm; spikes five to eight, approximated and often forming a head, mostly short-oblong or nearly globular, compactly fifteen- to thirty-flowered, green; perigynium ovate-lanceolate, spongy-thickened below, rough on the angles above, nerved on both faces, spreading or somewhat reflexed, the beak long and prominent, longer than the sharp white and thin scale. E. Pennsylvania, *Porter;* Ashland, Mass., *Morong;* Tompkins Co., N. Y., *Dudley;* Jefferson Co., N. Y., *Crawe;* and Keweenaw Co., Michigan, *Farwell.* Before fully mature, the spikes are not stellate, and specimens may readily be mistaken for *C. canescens*, var. *polystachya*, Boott, to which plant Morong's specimens were referred in my Synopsis. (See addendum.)

Var. CONFERTA, Bailey, Carex Cat. (1884.)

C. stellulata var. *conferta*, Chapm. Flora S. States, 534. (1860.)

Very stiff; spikes contiguous or scattered, spreading, globular or short-oblong, densely flowered; perigynium broadly ovate or even nearly round-ovate, very strongly nerved, reflexed or spreading. Near the sea-coast from Newfoundland to Florida.

Var. MICROSTACHYS, Bœckeler, Linnæa, xxxix. 125 (1875.)

C. sterilis, Willd. Sp. Pl. iv. 208 (1805), v. s. Hb. Willd.

C. scirpoides, Schkuhr, Riedgr. Nachtr. 19, f. 180 (1806), v. s. Hb. Schk.

C. stellulata, vars. *scirpoides* and *sterilis*, Carey, Gray's Man. 1848, 544.

C. echinata, var. *microstachya*, Bœckl. Flora, 1875, 563.

C. echinata, var. *microcarpa*, Bailey, Coulter's Man. Rocky Mt. Bot. 395 (1885.)

Mostly very slender and often weak; spikes few, three- to ten-flowered, usually tawny; perigynium small, lance-ovate, nerved on the outer face but usually nerveless on the inner, erect or spreading, the beak rather long. From Canada to the Gulf States, and evidently across the continent. Common and variable.

Var. ANGUSTATA, Bailey, Carex Cat. (1884.)

C. stellulata, var. *angustata*, Carey, Gray's Man. 1848, 544.

Very slender; spikes few and very few-flowered, mostly all contiguous; perigynium lanceolate or linear-lanceolate, twice or more the length of the scale. New York, Vermont and northward. Rare.

82.—CAREX FULVA, Gooden., was described by its author as coming from Newfoundland as well as England. With the exception of an adventitious plant found over fifty years ago at Tewksbury, Mass., by B. D. Greene, the plant has not been catalogued from America since Goodenough's time. Goodenough's originals in Hb. Kew. explain the perplexity. Part of the sheet is *C. fulva*, and part is an immature form of *C. flava* (evidently *C. flava* var. *graminis*, Bailey). The *C. flava* is undoubtedly the Newfoundland plant.

83.—CAREX ROSTRATA, Stokes, in With. Arr. Brit. Pl. 2nd Ed. 1059 (1787).

Jonathan Stokes assisted in the preparation of Withering's second edition, and his initials are appended to the above species. Although Withering's Carices are not known to be in existence, there can be no doubt that the *C. rostrata* of Stokes is the same as *C. ampullacea* of Goodenough. Stokes refers to Leer's figure of *C. vesicaria*, *α* (Fl. Hert. t. 16, 2), and this figure is unmistakably Goodenough's *C. ampullacea*. It is a singular circumstance that Schkuhr in the index to his Nachtrag (1806) makes "*C. rostrata*, Weith." a synonym of *C. ampullacea*. "Weith." is undoubtedly meant for "With." Hudson's *C. vesicaria* (Fl. Angl. Ed. i. 353 (1762)) is the same plant.

84.—CAREX UTRICULATA, Boott, Hook. Fl. Bor.-Am. ii. 221 (1840), v. s. Hb. Boott.; Ill. 14, t. 39 (1858.)

C. ampullacea, var. *utriculata*, Carey, Gray's Man. 1848, 566.

C. rostrata, var. *utriculata*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 67 (1886.)

A study of much material, in field and herbarium, renders the differences between the European *C. rostrata* and our plant apparent. Ever since collecting the slender form of our plant

which has been referred to the European species, and failing to detect the stoloniferous character which is characteristic of *C. rostrata*, it has appeared that the two plants are specifically distinct. From the European species, *C. utriculata* is separated by grosser habit, lack of stoloniferous character, broader and proportionately shorter leaves, heavier and more scattered spikes, of which the lower are less peduncled, and much sharper scales. *C. rostrata* is a much neater plant, with slim, compact and evenly cylindrical spikes which are somewhat approximated near the top of the culm. Our species runs imperceptibly into

Var. MINOR, Boott, l. c.

C. utriculata, var. *globosa*, Olney, Bot. King's Rep. 374. (1871).

C. rostrata, Bailey, l. c.

Smaller throughout; leaves narrower and less nodulose; spikes 2½ in. or less long; perigynium smaller; scales muticous. With the species.

85.—WAHLENBERG'S CARICES.

Aside from the species reviewed in the preceding pages the following have been seen:

v. s. Hb. Wahl.

C. microglochin.

C. Buxbaumii: C. fusca, All.

C. ustulata: C. atrofusca, Schk.

C. pedata.

C. canescens, var. *alpicola.*

C. tenuiflora.

C. lagopina.

C. glareosa.

C. aquatilis. It is not certain that the American plant is the same as the European.

v. s. Hb. Holm.

C. castanea, Köngl. Acad. Handl. xxiv. 155 (1803). *C. flexilis*, Rudge, Linn. Trans. vii. 98, t. 10 (1804), v. s. Hb. Kens.

C. cladostachya, *C. polystachya*, and *C. scabrella* are in Hb. Swartz.

The following of Wahlenberg's originals do not appear to be

in existence: *C. tribuloides, leptalea, Pyrenaica, grisea, prasina, xanthophysa.* In Thunberg's herbarium, at Upsala, is a specimen called *C. latifolia*, but evidently not labelled by Wahlenberg himself, and it is *C. plantaginea*, Lam., as commonly supposed. The figures in Schkuhr with which Wahlenberg compares his *C. grisea* and *C. tribuloides* are unmistakable, and the conditions of publication of *C. leptalea* also leave no doubt as to the disposition of this species (*C. polytrichoides*, Muhl.). Schkuhr's figure of *C. miliacea*, which Wahlenberg cites under his *C. prasina* (Fl. Lapp. 250), is less characteristic.

86.—Muhlenberg's Carices

Aside from those heretofore mentioned:

v. s. Hb. Willd.

C. marginata: C. Pennsylvanica, Lam.

C. granularis.

C. pubescens.

C. polytrichoides.

C. cephalophora.

C. pedunculata.

C. retroflexa: C. rosea, var. *retroflexa*, Torr.

C. sparganioides.

C. multiflora: C. vulpinoidea, Michx., a slender-spiked form.

C. virescens, a slender and short-spiked form. *C. triceps* var *hirsuta*, Bailey, is also on the same sheet, but the description applies to *C. virescens.*

C. trichocarpa.

C. pellita: C. filiformis, var. *latifolia*, Bœckl.

C. hystricina.

C. miliacea: C. prasina, Wahl.

C. stipata.

87.—Willdenow's Carices, addendum:

v. s. Hb. Willd.

C. lucorum: C. Pennsylvanica, Lam.

C. supina: C. obesa, var. *minor*, Boott. Perhaps worthy of specific rank.

C. sterilis: C. echinata, var. *microstachys*, Bœckl.

C. digitalis.

C. lacustris: *C. riparia*, Curt.

C. folliculata: *C. intumescens*, Rudge.

C. macrocephala.

C. juncea: *C. ferruginea*, Scop.! This species is recorded as coming from North America, and Kunth and others have made the name supplant Buckley's *C. miser*, a name applied to a local species from the mountains of North Carolina. Willdenow founded his species upon cultivated plants, which were evidently mixed in the garden. The specimens included in the cover of *C. juncea* are of two species. Sheet No. 1, taken by Kunth as the type, is *C. ferruginea*, Scop. The other sheets, as indicated by Kunze in the herbarium, are *C. umbrosa*, Host. Buckley's name, *C. miser*, must therefore stand for the American plant.

C. inundata, Willd, in herb.; Schlecht. Linnæa, x. 267: *C. verrucosa*, Muhl.

C. pinetorum, l. c.: *C. Muhlenbergii*, Schk.

C. Bosci, Willd. in herb.; Spreng. Syst. Veg. iii. 812 (1826); Schlecht. l. c.: *C. stipata*, Muhl.

C. lonchicarpa, Willd. in herb.; Spreng. l. c.: *C. folliculata*, var. *australis*, Bailey.

C. Norvegica, v. s. Hb. Schk.

88.—SCHKUHR'S PLANTS, addendum; v. s. Hb. Schk.

C. polygama: *C. fusca*, All.

C. oligocarpa.

C. conoidea.

C. laxiflora: *C. grisea*, Wahl.

C. atrofusca.

C. umbellata.

C. rosea.

C. scirpoides: *C. echinata*, var. *microstachys*, Bœckl.

C. lagopodioides: *C. tribuloides*, Wahl.

C. scoparia.

C. refracta, Schk.* in Willd. Sp. Pl. iv. 297 (1805); Riedgr. Nachtr. 62, f. 136 (1806). *C. tenax*, Reuter, Compte Rendu Trav. Soc. Hallérienne, 1852–'6, 130!

---

*There is often uncertainty as to whether Willdedow or Schkuhr should be cited as authority for species which were published almost simultaneously. In the index to his Nachtrag, Schkuhr appears to be careful to give proper credit for the suggestion of the name, and I have followed him.

This species has been the occasion of misunderstanding from Schkuhr's time to the present.* Neither European nor American botanists have taken it up, although credited to both countries. It has been, perhaps, the most puzzling feature in our Carex synonymy. The best specimens are in Willdenow's herbarium. Professor Ascherson suggested to me the identification of the plant with Reuter's *C. tenax* of the Italian Alps.

The three following of Schkuhr's species are not in his herbarium, nor in Willdenow's: *C. bullata, tetanica, Muhlenbergii.*

C. bromoides and *C. Willdenovii* are in Hb. Willd.

89.—ALLIONI'S PLANTS. v. s. Hb. All.

C. rupestris.

C. juncifolia: *C. incurva*, Lightf.

C. fœtida.

C. nigra: *C. atrata*, var. *nigra*, Boott.

C. bicolor.

C. fusca, All. Fl. Ped. ii. 269 (1785). *C. polygama*, Schk. Riedgr. 84, t. 76 (1801), v. s. Hb. Schk. *C. Buxbaumii*, Wahl. Köngl. Acad. Handl. xxiv. 163 (1803), v. s. Hb. Wahl. Although Allioni places this species in the section characterized by "Spicis pluribus sexu distinctis: mare unica," it has an androgynous terminal spike. It is represented by a good specimen.

C. frigida.

C. patula: *C. sylvatica*, Huds.

C. bipartita: *Kobresia caricina*, Willd. Allioni's figure of this plant is not characteristic, yet the specimens are unmistakable and their history is clear. In Balbis' herbarium, at Turin, the same plant is labeled *C. bipartita.*

Some of Allioni's species are not known to be in existence, and his figures are poor. His figure of *C. trigona*, however, appears to leave no doubt that he meant the plant named by Linnæus *C. distans.*

90.—LAMARCK'S CARICES, addendum; v. s. Hb. Lam.

C. Magellanica.

---

*For a brief discussion of the perplexity, consult Proc. Amer. Acad. Arts and Sci. xxii. 118, 1886.

C. Pennsylvanica.

C. plantaginea.

C. crinita.

91.—MICHAUX'S CARICES, addendum; v. s. Hb. Michx.

C. leporina: In part *C. scoparia*, Schk., and in part a small form of *C. straminea*, Willd.

C. subulata.

C. rostrata: C. Michauxiana, Bœckl.

C. oligosperma.

C. typhina: C. squarrosa.

C. lanuginosa: C. filiformis, var. *latifolia*, Bœckl.

C. lenticularis. One specimen is a much reduced *C. stricta*, Lam.

C. paupercula: C. Magellanica, Lam.

C. scirpoidea.

C. microstachya: C. polytrichoides, Muhl. In Michaux's herbarium the plant is labelled *C. leptostachya.* The name was evidently changed when put into print.

C. vulpinoidea. A small form.

C. Richardii: type of *C. canescens*, L. A specimen from Paris and one from Canada. Michaux attributes the name to Thuill.

C. folliculata: C. intumescens, Rudge.

C. plantaginea: C. platyphylla, Carey.

92.—DREJER'S CARICES, addendum; v. s. Hb. Havn.

C. anguillata. Appears to be a good species. From *C. vulgaris*, var. *hyperborea*, it is distinguished by its elliptic, papery, whitish and puncticulate perigynia, obovate and obtuse scales, and looser-flowered spikes. T. MMDCCCXLVI. Flora Danica, is a characteristic plate. The original specimens are from Iceland, but Lange reports it from Greenland, also. Dr. Boott referred the species to *C. aquatilis*, var. *minor*, Boott.

C. holostoma. I referred this plant to *C. alpina* as var. *holostoma* (Proc. Amer. Acad. Arts and Sci. xxii. 76). It appears to be a well characterized species, however. T. MMCCCCXXVIII. Fl. Danica, is a good illustration of it.

C. hyperborea: *C. vulgaris* var. *hyperborea*, Boott. Vars. *infuscata*, *lutosa* and *pudica* of *C. rigida*, are apparently mere incidental forms of *C. vulgaris* var. *alpina*, Boott.

C. nigritella: *C. stylosa*, Meyer.

C. lagopina, var. *pleiostachya* does not appear to be worth separating.

C. pratensis.

C. stans. Following Dr. Boott, I should call this a form of *C. aquatilis*, Wahl.

C. reducta: *C. subspathacea*, Wormsk.

C. subspathacea, vars. *stricta* and *curvata*: *C. subspathacea*, Wormsk.

93.—OTHER DANISH-GREENLAND CARICES; v. s. Hb. Havn.

C. canescens, vars. *robusta* and *robustior*, Blytt, appear to be inseparable from the species.

C. Drejeriana, Lange, Fl. Dan. fasc. 50 (1880), 10, t. MMDCCCCLXXV. (not *C. Drejeri*, Lang). The table is characteristic, except that it appears to represent the leaves as rather too broad. Perigynium elliptic-oblong, thin and light-colored, very blunt, exceeding the obtuse purple white-nerved scale, nerveless and puncticulate. The peduncled and short spikes are characteristic of the species.

C. lagopina, var. *debilis*, Lange, Fl. Groen. 135 (1880);

C. misandra, var. *elatior*, Lange, l. c. 140. Both these varieties are well marked.

C. rotundata, var. *elatior*, Lange, does not appear to differ in any important respect from the species as it occurs in Scandinavia.

C. rigida, var. *inferalpina*, Læst.: *C. vulgaris*, var. *hyperborea*, Boott.

C. Grœnlandica, Lange, Fl. Grœn. 144 (1880), Fl. Dan. t. 2845, appears to be inseparable from *C. vulgaris*, var. *hyperborea*, Boott.

C. Fyllæ, Holm, is *C. vulgaris*, var. *alpina*, Boott, perhaps with somewhat broader leaves than usual.

C. Warmingii, Holm, is *C. vulgaris*, var. *hyperborea*, Boott, a short form.

C. duriuscula, Meyer, of Fl. Grœn. appears to be small *C. incurva*, Lightf.

In this connection it may be remarked that var. *subloliacea*, Læst. of *C. canescens*, is a very different plant from *C. canescens*, var. *vulgaris*, Bailey. (See Bot. Gaz. xiii. 85, where remarks were made concerning these plants). As compared with the var. *vulgaris*, var. *subloliacea* has shorter and rounder perigynia,—more like those of the type of the species,—and which are silvery in color and somewhat puncticulate.

94.—LIEBMANN'S MEXICAN CARICES addendum;

v. s. Hb. Liebm.

C. Cortesii: C. Jamesoni, Boott.

C. chordalis: C. Jamesoni, var. *gracilis*, Bailey, Bot. Gaz.. xiii. 88; *C. Jamesoni*, *β*. Boott.

C. Orizabæ: C. festiva, Dewey.

C. leporina, var. *bracteata: C. straminea*, var. *fænea*, Torr.

C. melanosperma. It has the aspect of forms of C. *Jamesoni*, Boott, but the perigynia are very different (see No. 79). The "rough-ciliate mucro" of the pistillate scales is not pronounced.

C. maculata is *C. psilocarpa*, Steud. Pl. Cyp. 195 (1855). Boott's *C. maculata* is an older name.

C. olivacea: C. monticola, Bœckl. Engler's Bot. Jahr. i. 364 (1881); *C. androgyna*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 101 (1886). Boott's *C. olivacea* is an older name.

C. anisostachys. A fine species, allied, with the last, to *C. virescens*, Muhl. *C. monticola* has more the port of *C. virescens*, as the pistillate portion of the terminal spike is longer than in this species. *C. anisostachys* has toothed perigynia, while those of *C. monticola* are entire, and the scales in *C. anisostachys* are much more acute than in the other. The terminate spike is rarely all staminate.

Var. CHLOROCARPA.

C. chlorocarpos, Liebm.

C. Liebmanni, Walpers.

Lower (6–12 in. high), and more slender, the leaves not hairy, (they are very slightly so in the species); spikes smaller; peri-

gynium usually shorter and scales commonly more obtuse. Simply a reduced form of *C. anisostachys.*

C. tuberculata. A clear species, with somewhat the port of narrow-spiked *C. verrucosa*, Muhl.

C. rhynchophysa: *C. physorhynca*, Steud. Bœckeler (Engler's Bot. Jahr. i. 364), refers this species to *C. nigro-marginata*, Schw. I can see no essential difference between the plant and *C. nigro-marginata*, but as this species has not been found south of Carolina, the union may be delayed until more material accumulates.

C. turbinata. (See No. 48). Much like *C. communis*, Bailey, from which it is distinguished, among other things, by the strongly nerved pergynia. *C. rigens* Bailey, appears to be a distinct species, and the following points of contrast between the two may be made: *C. turbinata:* Culms rather slender; staminate spike not prominent; bracts narrow, usually not much prolonged; perigynium very short-beaked and entire; scales hyaline-brown on the margins, obtuse or muticous, not prominently nerved. Schaffner's No. 222 from San Luis Potosi is this species (v. s. Hb. Berol., where it is named *C. Halleriana* by Bœckeler); *C. rigens*: Culms stout and stiff; staminate spike large and prominent; bracts, particularly the lowest, leaf-like and longer (3 to 4 in. long); perigynium larger, longer beaked, the beak sharply cut into short membranaceous white teeth; scales very acute or rough-awned with white-hyaline margins, green nerved on the back.

v. s. Hb. Örst.

C. Örstedii. Much like C. *cladostachya*, Wahl., but the panicle contains fewer spikes (3 to 4 spikes, or sometimes more), which are longer and more erect; perigynium straight or nearly so, not divergent, less strongly nerved. Plant stouter and more erect than *C. cladostachya.* Evidently nearer *C. polystachya*, Wahl.

C. acrolepis. Looks much like a small and abnormal *C. cladostachya.* Spikes very few in the panicle, sometimes reduced to one and never more than three, staminate portion very small or even wanting, ascending or erect; perigynium erect and straight, the scales very sharp and

rough. It has even somewhat the aspect of *C. anisostachys.*

95.—ROBERT BROWN'S NORTH AMERICAN CARICES.*

All but *C. attenuata*, are in the herbarium of the Natural History Museum at South Kensington. This species was seen in Hb. Hooker. by Dr. Boott, and by him referred to *C. rupestris* All.

C. affinis, R. Br. Frankl. Narr. App. 763, was referred by Dr. Boott to *C. obtusata*, Lilj. Three sheets were placed together in the museum, the specimens all collected on the same expedition, of which two sheets are not labelled, but are evidently *C. obtusata*, although too young for positive determination. The third sheet is Brown's type of *C. affinis*, and is *Kobresia scirpina*, Linn.

C. concolor, Suppl. App. Parry's Voy. 218: *C. vulgaris*, var. *alpina*, Boott.

C. podocarpa, Frankl. Narr. App. ed. ii. 36, has been entirely misunderstood. It is apparently a form of *C. atrofusca*, Schk. (*C. ustulata*, Wahl.). From most specimens of *C. atrofusca* it differs more or less in the entire orifice of its perigynium, which is not at all puncticulate, somewhat narrower spikes, and broader leaves. But *C. atrofusca* is a variable species, and in the absence of more and better material, I throw the two together for the present. The plant which has passed for *C. podocarpa* R. Br. (Boott. Ill. 197; Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 94), is *C. macrochæta*, Meyer.

The following species are properly understood by American botanists:

C. aristata, Frankl. Narr. App. 764: *C. trichocarpa* var. *aristata*, Bailey.

C. Richardsoni, Frankl. Narr. App. 763.

C. misandra, Suppl. Parry's Voy. 283.

C. concinna, Frankl. Narr. App. 763.

C. compacta, Ross's Voy. App. cxliii.

C. media, Frankl. Narr. App. 763: *C. alpina*, Swtz.

C. mutica, Frankl. Narr. App. 763: *C. aurea*, Nutt.

*Most of the notes on Brown's and Rudge's Carices were also printed in Journ. Bot. xxvi. 321–323 (Nov. 1888).

96.—PRESL'S CARICES, addendum; v. s. Hb. Presl.

C. anthericoides: *C. macrocephala*, Willd.

C. Mexicana: *C. cladostachya*, Wahl.

C. anthoxanthea: *C. leiocarpa*, Meyer.

There is some doubt as to the priority of these last two names. Presl published *C. anthoxanthea* in 1830. Meyer presented his paper, in which was published *C. leiocarpa*, in 1825, but the Memoirs of the St. Petersburg Academy, in which it was printed, did not appear until 1831. Meyer's paper was separately distributed, however, and it is probable that it was published soon after 1825.

97.—STEUDEL'S NORTH AMERICAN CARICES, addendum:

(The figures refer to pages in Steudel's Synopsis Plantarum Cyperacearum.)

v. s. Hb. Steud.

C. picta, 184. (Not Boott, 1859.): *C. Boottiana*, Bentham; Boott in Journ. Bost. Nat. Hist. Soc. v. 112 (1845), v. s. Hb. Boott.; (not Hook. & Arn*.)

C. flaccidula, 199: *C. rosea*, Schk.

C. Fridrichsthaliana, 211: *C. vulgaris*, var. *hyperborea*, *Boott.*

C. subcompressa, 221: *C. prasina*, Wahl.

C. microsperma, 231: *C. flaccosperma*, Dewey.

C. basiantha, 232: *C. Willdenowii*, Schk.

C. amphibola, 234: *C. grisea*, var. *angustifolia*, Boott.

C. nana, Cham.: *C. capillaris*, Linn.

v. s. Hb. Lenorm.

C. abjiciens, 209: *C. Magellanica*, Lam.

C. Despreauxii, 237: *C. oligosperma*, Michx.

C. Beringiana, Cham. 229: *C. stylosa*, Meyer.

v. s. Hb. Berol. (Drummond's numbered specimens.)

C. oblita, 231: *C. venusta*, var. *minor*, Bœckl. (*C. glabra* Boott. *C. venusta*, var. *glabra*, Bailey.)

C. podostachys, 232: *C. digitalis*, Willd.

C. protracta, 234: *C. laxiflora*, var. *styloflexa*, Boott.

C. hyalinolepis, 235: *C. riparia*, Curtis. (Also v. s. Hb. Kew.)

C. Macroklea, 223: *C. verrucosa*, Muhl. (Also v. s. Hb. Kew.)

**C. BOOTTIANA*, Hook. & Arn. Bot. Beechey's Voy. 273 (1841). *C. Bongardiana*, Boott, Linn. Trans. xx. 144 (1845–6). Loo Choo.

Teste Bœckeler.

C. Kelvingtoniana, 215: *C. stricta*, Lam.

C. Watsoniana, 215: *C. stricta*, Lam.

C. rufidula, 220: *C. verrucosa*, Muhl.

C. aureolensis, 223: *C. stenolepis*, Torr.

C. familiaris, 226: *C. oxylepis*, Torr. and Hook.

C. chlalaros, 231: *C. granularis*, Muhl.

C. subbiflora, 234: *C. Pennsylvanica*, Lam. (Flora, 1856, 327.)

C. subuniflora, 234: *C. oligocarpa*, Schk.

C. Baazasana, 236: *C. Cherokeensis*, Schw.; also *teste* Boott.

C. nivalis, Cham. 184: *C. Pyrenaica*, Wahl.; (*C. micropoda*, Meyer, according to Boott).

C. spaniocarpa, 225 is founded upon t. 2176, Fl. Danica. This plate is *C. supina*, Willd. (*C. oligocarpa*, Hornem.), *teste* Lange, Nomen. Fl. Dan. 81 (1887).

98.—Bœckeler's North American Carices, addendum:

v. s. Hb. Berol.

C. pilosiuscula, Flora, 1882, 61: *C. Whitneyi*, Olney.

C. longicaulis, l. c. 62. Allied to *C. triquetra*, Boott, and *C. pubescens*, Muhl.

C. Ehrenbergiana. Has much the aspect of *C. crinita*, Lam., and *C. Prescottiana*, Boott. Perigynia very small for a species of its group.

C. Krausei, Bot. Jahr. 1886, 279; *C. capillaris*, var. *Krausei*, Krantz; Macoun, Pl. Can. iv. 163: *C. capillaris*, L.

C. Alaskana, l. c.: *C. gynocrates*, Wormsk.

C. Urbani, l. c.: *C. flava*, var. *viridula*, Bailey.

C. Saskatchewana: *C. capillaris*, L. Leaves rather unusually broad.

C. Fendleriana: *C. Douglasii*, Boott.

C. grisea, var. *minor*: *C. grisea*, var. *angustifolia*, Boott.

C. Virginiana, var. *elongata*: *C. stricta*, var. *Emoryi*, Bailey.

C. Deweyana, var., Linnæa, xxxix. 129: *C. longirostris*, Torr.

C. heptastachya, said to have come from Merida, Costa Rica, comes from Merida, Colombia, according to the label.

The species may be inseparable from tall forms of *C. straminea*, Willd.

C. brizoides, var. *nemoralis*, Wimmer, credited to Arctic America, does not occur in this country. This variety is the plant originally described by Linnæus, and the first application of the name should be restored.

C. tenuispica, Flora, 1856, 225, *C. tristicha*, Flora, 1858, 651, is *C. stricta*, Lam. (*teste* Bœckl. Linnæa xl. 431).

C. leucocarpa, Flora, 1856, 227: *C. Pennsylvanica*, Lam.

99.—SCHWEINITZ'S CARICES, addendum:

v. s. Hb. Schw.

C. costata: *C. virescens*, Muhl. var. *costata*, Dewey.

C. sempervirens: *C. verrucosa*, Muhl.

C. albolutescens: *C. straminea*, var. *fœnea*, Torr.

C. cristata: *C. tribuloides*, var. *cristata*, Bailey.

C. Pseudo-Cyperus: *C. Pseudo-Cyperus*, var. *Americana*, Hochst.

C. scabrata.

C. retrorsa.

C. Novæ-Angliæ.

C. nigro-marginata.

C. gracillima.

There are two tolerably well marked forms of *C. gracillima*. Schweinitz described the tall and broad-leaved form which grows in rich woods and copses. In open places and on harder soils, the species becomes dwarfed, and may then be known as

Var. HUMILIS.

Smaller, the leaves narrower; spikes often very small, two- to twelve-flowered, erect or ascending; perigynium mostly smaller.

C. Muskingumensis (*C. arida*, Schw. and Torr.).

*C. Cherokeensis.**

C. Deweyana.

**C. recurva*, Muhl., an older name for *C. Cherokeensis*, is incapacitated by Schkuhr's species:

C. RECURVA, Schkuhr, 1801.

C. Forsteri, Wahl., 1803. New Zealand.

C. Floridana.

C. Schweinitzii, Dewey.

C. granularioides : *C. conoidea.*

C. gynandra : *C. crinita.*

C. acuminata : *C. laxiflora*, var. *styloflexa*, Boott.

C. littoralis, Schw. 1824, is not in his herbarium, but it is an older name for *C. Barrattii*, Schw. and Torr., 1825, *teste* Schw. and Torr., and should stand. *C. variegata*, Scheele, Linnæa, xxiii. 565 (1850), is the same.*

C. stolonifera, Schw., according to the description, is *C. Pennsylvanica*, Lam. A specimen in the herbarium labelled *C. stolonifera*, with a query, is also *C. Pennsylvanica.*

C. Torreyana, Schw., is not in the herbarium. The description indicates that *C. monile* or *C. Tuckermani* was meant.

A specimen of *C. panicea*, L. from Boston, collected by H. Little, is in Hb. Schw., showing that the species has long been naturalized.

100.—MISCELLANEOUS NOTES.

C. intumescens, Rudge, Linn. Trans. vii. 97, f. 3, v. s. Hb. Kens., is properly understood by botanists.

C. flexilis, Rudge, l. c. is *C. castanea*, Wahl.

C. folliculata, Rudge, l. c. is *C. Michauxiana*, Bœckl.

C. commutata, Gay, Ann. Sci. Nat. 2nd ser. xi. 198, v. s. Hb. Paris., is *C. stricta*, Lam.

C. crus-corvi, Shuttl. is in Shuttleworth's herbarium at South Kensington, and is the species understood by botanists.

C. Tuckermani should be credited to Dewey rather than to Boott: Dewey, Sill. Journ. (I.), xlix. 48 (1845), and *teste* Dewey in Herb.; Boott, Linn. Trans. xx. 115 (1846).

C. flacca, Schreber, Spic. Fl. Lips., addendum (1771). *C. glauca*, Scopoli, Fl. Carniol. 2nd ed. ii. 223 (1772); Fl. Carniol. 1st ed. 214, without name (1760).

C. styloflexa, Buckley, v. s. Hb. Torr., is *C. laxiflora*, var. *styloflexa*, Boott.

---

* *C. littoralis*, Petrie, Trans. New Zealand Inst. xv. 358, a recent species, may be known as C. LITOROSA.

ADDENDA.

CAREX STRAMINEA, Willd., var. RENIFORMIS.

Intermediate between var. *hyalina*, Boott, and var. *brevior*, Dewey : Spikes about four or five, all contiguous in an erect head, almost perfectly globular, dull greenish-tawny ; perigynium thin and flat, broader than long and almost or quite reniform, the short beak very distinct, the wing margins very thin ; plant about 18 in. to 2 ft. high, rather slender. Mississippi : Bogue Phalia, *Mohr*, Starkville, *Tracy*. E. Louisiana, *Langlois*.

CAREX CRINITA × TORTA.

More slender than *C. crinita*, the leaves narrower ; spikes nearly as slender as those of *C. torta* ; scales muticous or simply acute and little longer than the perigynium, or sometimes very short-awned. Moist meadows near the "Glen House," White Mountains, *Brainerd*.

C. LURIDA, Wahl. (*C. tentaculata*, Muhl.), var. FLACCIDA.

Low, scarcely exceeding a foot or fifteen inches high ; spikes two to four, all sessile and approximated at the top of the culm, small and straight (an inch or less long), dull brown or reddish-brown, loosely flowered ; perigynium very thin and membranaceous, the body mostly larger than in the species and more gradually contracted into the beak. Central N. York, *Dudley*, to New Jersey, *Ellis*. Its spikes lack entirely the dense and hystricinous aspect of the species. It is not improbable that it may be a mixture with *C. lupulina*, Muhl.

C. LURIDA × LUPULINA.

C. tentaculata, Muhl., var. *rostrata*, Sartwell, Exsicc. No. 138 (1848), v. s.

C. tentaculata, Muhl., var. ? *altior*, Boott, Ill. 94, t. 278 (1860).

C. tentaculata × *lurida*, Bailey, Proc. Amer. Acad. Arts and Sci. xxii. 69 (1886), mostly.

Much like some forms of *C. lurida*: Staminate spike sessile or very nearly so, after the manner of *C. lupulina*; pistillate spikes three or four, all approximated or nearly so, or the lowest separated, all sessile, erect or spreading, straight or often somewhat curved, densely flowered, green; perigynium long-beaked and ascending, causing the spike to lack the comose appearance of *C. lurida.* Very like *C. lupulina* × *retrorsa*, Dudley, but that plant has shorter and much looser, scattered spikes which are yellow or straw-colored and perigynium large and very thin and soft in texture. Amherst, Mass., Tuckerman, according to Boott; Wethersfield, Conn., *C. Wright*; Penn. Yan, N. Y., *Sartwell.*

C. VULGARIS, Fries, var. STRICTIFORMIS.

C. limula? Gray, Man. 5th ed. 582 (1867).

Tall and lax (1½ to 2½ ft. high), the leaves long and narrow; staminate spike, longer peduncled; pistillate spikes looser and often longer than in the species, the perigynia never being so densely packed and usually becoming browner. Lower St. Lawrence, *Pringle* (distr. as *C. limula*, Fries); Nova Scotia, *Macoun*; Mt. Desert, Maine, *Greenleaf, Rand;* Dorchester, Mass., *Churchill;* Nantucket, *Morong*, and southward to E. Pennsylvania.

This plant stands midway between *C. vulgaris* and *C. stricta.* From the latter it is distinguished by not growing in tufts, its narrower and smoother leaves and very obtuse black or brown and white-nerved short scales.

CAREX PENNSYLVANICA, Lam., var. VESPERTINA.

Habitually taller than the species, very slender; staminate spike commonly slimmer and usually very short-peduncled; pistillate spikes more separated and the lowest subtended by a leafy bract from one-half inch to one inch long; perigynium mostly larger, more hairy, the beak longer and stouter. Oregon, "Dry hills near the cascades of the Columbia," *Howell*, and *Henderson* 1782, without locality; lower cascades of the Columbia, and Mt. Adams, *Howell;* "dry rocky places," Vancouver Island and British Columbia, *Macoun.* The Pacific coast representative of *C. Pennsylvanica.* In aspect it is much like *C. communis*, Bai-

ley, but is distinguished by the stoloniferous habit, the very narrow and dull leaves and the habitually darker spikes.

CAREX AUREA, Nutt., var. CELSA.

Taller than the species (15 to 20 in. high) and strict; spikes large and compactly flowered, evenly cylindrical, longer peduncled. San Bernardino Mts., California, *G. R. Vasey*, Portland, Oregon, *Henderson*, *Howell*. Very distinct in appearance.

CAREX CANESCENS, var. POLYSTACHYA, Boott, Rich. Journ. ii. 344.

C. arcta, Boott, Ill. 155, t. 497 (1867).

C. Kunzei, Olney, Exsicc. fasc. iv. No. 19 (1872).

Erect and mostly strict, not glaucous, 1½ to 2½ ft. high; leaves very lax and usually exceeding the culm; spikes oblong, green, more or less aggregated into a loose head, the lowest one or two subtended by a short and hyaline broad-based and pointed or caudate bract; perigynium more spreading than in the species. Maine, *Scribner*; Barnet, Vermont, *Blanchard;* "Low woods near the outlet of Lake Champlain," *Pringle;* low woods, extreme northern Minnesota, *Bailey;* "Canada, *Macræ*, Lake Superior, Rainy Lake, Lake of the Woods, *Sir J. Richardson*, (1848-9)," Boott. This plant represents in *C. canescens* the same variation that var. *cephalantha* represents in *C. echinata*. The two plants are much alike, but this is readily distinguished from *C. echinata*, var. *cephalantha*, Bailey, by the ascending and canescens-like small and marginless perigynia and the presence of scale-like bracts beneath the lower spikes. The specimens from Maine and Vermont, cited above, do not appear to have had the long and lax leaves so characteristic of the species as found farther northward and westward, and as figured by Boott. Future observation may detect varietal differences here.

Var. OREGANA.

C. Kunzei, Olney, Proc. Am. Acad. Arts and Sci. viii. 406 (1872), Excl. synonymy.

C. canescens, var. *polystachya*, Bailey, in part, Proc. Amer. Acad. Arts and Sci. xxii. 144 (1886).

Head larger and more dense than in var. *polystachya*, becoming brown; spikes loosely flowered, the perigynia sometimes

spreading in a stellate manner; perigynium narrow, often almost linear-lanceolate, brown-nerved, sharp-edged and rough above. Oregon: Portland, *Henderson*, Sauvies' Island and North Yamhill, *Howell;* Falcon valley, Washington, *Suksdorf;* Vancouver Island, *Macoun.*

CAREX VIRESCENS, Muhl.

Muhlenberg described the small form of this plant, which grows upon dry and sterile soil. The large form appears to be worth recognition:

Var. COSTATA, Dewey, Sill. Journ. (I). ix. 260 (1825).

C. costata, Schw. Ann. N. Y. Lyc. Nat. His. i. 67 (1824), v. s. Hb. Schw.

C. virescens, var. *elliptica*, Olney, Exsicc. fasc. iii. No. 21 (1872), v. s.

Tall, 1½ to 2½ ft. high, the leaves very numerous and long; spikes ranging from ½ or ¾ in. to nearly 2 in. long; perigynium more strongly ribbed than in the type. Evidently more common than the type.

CAREX GRACILLIMA × HIRSUTA.

C. hirsuta, var. *pedunculata*, Schw. & Torr. Monogr. 323 (1825), v. s. Hb. Barratt.

The plant has much the look of a slender *C. gracillima* with erect spikes, although it lacks the green color of the spikes of that species, and the perigynia are short and costate, like those of *C. triceps*, var. *hirsuta*, Bailey. Under a good magnifier the leaves disclose a little pubescence, and the perigynia show a tendency to roughness. Schweinitz and Torrey write as follows: "Spiculis oblongo-cylindricis, pedunculatis; foliis vix pubescentibus. * * This plant might be taken for a distinct species, were it not carefully examined in a living state. Its spikelets are three-fourths of an inch long, slender, and supported by peduncles half an inch in length." "In meadows, growing with *C. digitalis* [*C. gracillima*, Schw.] and the ordinary variety of *C. hirsuta*. Philipstown [Putnam Co.], Highlands of New York; rare, *Dr. Barratt.*" Not since collected.

BARRATT'S CARICES.—In 1840 Dr. Joseph Barratt prepared to publish a set of "North American Carices.". The sets appear

never to have been distributed, however. There are none of the plants in any of the large European herbaria, neither in Hb. Gray., nor Hb. Torr. In the library at Cambridge, Mass., is a set of Barratt's printed labels, but there is no record that specimens ever accompanied the labels. From the earliness of this collection, the distribution, had it taken place, would be extremely important. Request was made of Professor William North Rice, of the Wesleyan University, Middletown, Connecticut, where Barratt's collections now exist, for information concerning the carices, and he has kindly loaned me the collections since the preceding pages were in type. A set of 67 numbers is contained in a small volume, accompanied by printed labels. A printed slip indicates that the intended distribution was to contain only species growing in the vicinity of Middletown. "We have prepared fifty sets of Carices for volumes, to supply our botanical friends, and for exchanges. Great attention has been paid to note the exact period of flowering and fruiting of the Carices, in a table we have drawn up; a summary of which is here given, in latitude 41° N." The summary does not appear, unless reference is made to the record upon each label. It is interesting to note, as illustrating the extent of changes in nomenclature in our best known species, that of the 64 species and varieties only 23 bear names which are now current. In addition to the small set, there are two large fascicles containing North American species from various collectors, and with which a duplicate set of Barratt's collection is incorporated.

Dr. Barratt proposed a number of new names, which may be discussed in this connection:

C. lagopodioides, var. *nana*, is *C. tribuloides*, var. *reducta*, Bailey.

C. Pennsylvanica, var. *nebulosa*. In the separate set, this plant is a large form of *C. communis*, Bailey. In the general collection, however, the same label is applied to *C. communis*, var. *Wheeleri*, Bailey; and this latter specimen affords a new locality for this variety.

C. vesicaria, vars. *brachystachya* and *gracilis*, are rather small forms of *C. monile*, Tuckm.

C. virescens, var. *minima*. This is the small form of the

plant, but it is the one which Muhlenberg described (v. s. Hb. Willd.), and must therefore be taken as the type of the species.

C. vulpinoidea, vars. *glomerata* and *ambigua*, are both incidental variations of the species, although the former is uncommon and may merit recognition if the plant should be found to assume any degree of permanence.

The general collection contains the type of *C. hirsuta*, var. *pedunculata*, Schw. & Torr., which I had never been able to find. (See *C. gracillima* × *hirsuta* above). It also has the true *C. Novæ-Angliæ*, Schw., from Plainfield, Mass., coll. by Dr. Jacob Porter, and *C. deflexa*, var. *Deanei*, Bailey, from Essex, Mass., labelled "*C. varia.*" It is interesting to note that, in both collections, *C. varia* is represented by the true plant (*C. Emmonsii*, Dewey). Originals of Buckley's *C. Caroliniana*, *C. styloflexa*, and *C. miser* are also here. The specimen of *C. Caroliniana* is better than the one in Hb. Torr.—the only other known specimen,—although no mature perigynia remain upon it. It appears to be a good species.

INDEX.

C. abjiciens, Steud. 69.
acrolepis, Liebm. 67.
acuminata, Schw. 72.
acuta, Bailey, 52.
var. pallida, Boott, 17.
var. prolixa, Bailey, 52.
acutina, Bailey, 52.
adusta, authors, 25, 27.
var. argyrantha, Bailey, 25.
var. glomerata, Bailey, 25.
var. sparsiflora, Bailey, 27.
adusta, Boott, 24.
affinis, R. Br. 68.
Alaskana, Bœckl. 70.
alata, var. pulchra, Olney, 23.
albicans, Willd. 40.
albida, Bailey, 9.
albolutescens, Olney, 27.
var. argyrantha, Olney, 25.
var. glomerata, Olney, 24.
var. sparsiflora, Olney, 27.
albolutescens, Schw. 71.
alma, Bailey, 50.
alpestris, Dewey, 40.
alpina, Swartz, 68.
var. holostoma, Bailey, 64.
ambusta, Boott, 40,
amphibola, Steud. 69.
ampullacea, Gooden. 59.
var. borealis, Lange, 39.
var. utriculata, Carey, 59.
androgyna, Bailey, 66.
anguillata, Drejer, 64.
angustata, Boott, 19.
anisostachys, Liebm. 66.
var. chlorocarpa, Bailey, 66.
anthericoides, Presl, 69.
anthoxanthea, Presl, 69.
aperta, Boott, 52.
var. angustifolia, Boott, 16.
var. divaricata, Bailey, 18.
C. aquatilis, Wahl. 19, 60, 65.
var. minor, Boott, 64.
aquatilis, W. Boott, 18, 44.
arcta, Boott, 75.
argyrantha, Tuckm. 25.
arida, Schw. & Torr. 71.
aristata, R. Br. 68.
atrata, authors, 10.
var. discolor, Bailey, 10.
atrata, var. nigra, Boott, 63.
var. nigra, Olney, 10.
var. ovata, Boott, 10.
atrofusca, Schk. 60, 62, 68.
attenuata, R. Br. 68.
aurea, Nutt. 68.
var. celsa, Bailey, 75.
aureolensis, Steud. 70.
auriculata, Bailey, 19.
Baazasana, Steud. 70.
Barbaræ, Dewey, 44.
Barrattii, Schw. & Torr. 72.
basiantha, Steud. 69.
Bebbii, Olney, 55.
Bella-villa, Dewey, 12.
Beringiana, Cham. 69.
Beyrichiana, Bœckl. 11.
bicolor, All. 63.
bicostata, Olney, 57.
bipartita, All. 63.
Bolliana, Bœckl. 34.
Bongardiana, Boott, 69.
Bonplandii, Bailey, 15.
Bonplandii, var. angustifolia, W. Boott, 15.
var, minor, Boott, 15.
Boottiana, Benth. 69.
Boottiana, Hook. & Arn. 69.
Bosci, Willd. 62.
brevipes, W. Boott, 43.
brizoides, var. nemoralis, Wimmer, 71.
bromoides, Schk. 63.

C. Brongniartii, Bailey, 49.
Brongniartii, Boott, 50.
bulbosa, Bœckl. 33.
bullata, Schk. 63.
Buxbaumii, Wahl. 60, 63.
cæspitosa, Linn. 16, 17.
var. filifolia, Boott, 16.
Californica, Bailey, 9.
Canadensis, Dewey, 12.
canescens, Linn. 64.
vars. 65, 66.
var. alpicola, Wahl. 60.
var. Oregana, Bailey, 75.
var. polystachya, Bailey, 75.
capillaris, Linn. 69, 70.
Caroliniana, Buckley, 78.
Caroliniana, Schw. 34.
castanea, Wahl. 60, 72.
cephaloidea, Dewey, 5.
cephalophora, Muhl. 61.
Chapmanni, Steud. 33.
Cherokeensis, W. Boott, 9.
Cherokeensis, Schw. 70, 71.
chlalaros, Steud. 70.
chlorocarpos, Liebm. 66.
chordalis, Liebm. 66.
chrysites, Link, 30.
cladostachya, Wahl. 60, 69.
collecta, Dewey, 41, 44.
communis, Bailey, 41.
var. Wheeleri, Bailey, 41, 77.
commutata, Gay, 72.
comosa, Boott, 54.
compacta, R. Br. 38, 39, 68.
concinna, R. Br. 68.
concolor, R. Br. 68.
conoidea, Schk. 62, 72.
Coreana, Bailey, 8.
Cortesii, Liebm. 66.
costata, Schw. 71, 76.
crinita, Lam. 64, 72.
var. minor, Boott, 49.
crinita × torta, Bailey, 73.
cristata, Schw. 55, 71.
crus-corvi, Shuttl. 72.
cryptocarpa, Meyer, 27.
var. hæmatolepis, Bailey, 27.
var. pumila, Bailey, 27.
cuspidata, Wahl. 46.
C. Davisii, Dewey, 40.
debilis, Michx. 33.
var. prolixa, Bailey. 33.
var. Rudgei, Bailey, 34.
var. strictior, Bailey, 34.
deflexa, Hornem. 41.
var. Boottii, Bailey, 43.
var. Deanei, Bailey, 42.
var. media, Bailey, 43.
var. Rossii, Bailey, 43.
densa, Bailey, 50.
Despreauxii, Steud. 69.
Deweyana, Schw. 71.
var., Bœckl. 70.
digitalis, Willd. 61, 69.
var. copulata, Bailey, 47.
var. glauca, Chapm. 48.
disticha, authors, 8.
divisa, Œder, 29.
Donnell-Smithii, Bailey, 56.
Douglasii, Boott, 70.
var. brunnea, Olney, 20.
var? laxiflora, Bailey, 20.
Drejeriana, Lange, 65.
duriuscula, Meyer, 66.
echinata, Murray, 57.
var. angustata, Bailey, 59.
var. cephalantha, Bailey, 58.
var. conferta, Bailey, 58.
var. microstachys, Bœckl. 58, 62.
Ehrenbergiana, Bœckl. 70.
Eleocharis, Bailey, 6.
Emmonsii, Dewey, 40.
exsiccata, Bailey, 6.
familiaris, Steud. 70.
Fendleriana, Bœckl. 70.
ferruginea, Scop. 62.
festiva, Dewey, 66.
f. humilis, Bœckl. 23.
var. pachystachya, Bailey, 51.
var. stricta, Bailey, 51.
var. viridis, Bailey, 51.
festucacea, Willd. 22.
var. tenera, Carey, 21.
filiformis, var. australis, Bailey, 56.
var. latifolia, Bœckl. 64.
filipendula, Drejer, var. concolor, Drejer, 27.
var. variegata, Drejer, 27.

C. flacca, Schreber, 72.
flaccidula, Steud. 69.
flaccosperma, Dewey, 69.
flava, Host, 28.
flava, Linn, 28, 59.
vars., 28–30.
var. cyperoides, Marsson, 30.
var. elatior, Schlecht. 28.
var. graminis, Bailey, 30.
var. Œderi, Lilj. 29.
var. recterostrata, Bailey, 29.
var. viridula, Bailey, 31, 70.
flexilis, Rudge, 60, 72.
flexuosa, Muhl. 34.
Floridana, Schw. 72.
fœnea, Willd. 25.
var. ? ferruginea, Gray, 22.
var. perplexa, Bailey, 27.
fœtida, All. 63.
foliosa, Gaud. 28.
folliculata, Lam. 12.
folliculata, Michx. 64.
folliculata, Rudge, 72.
folliculata, Willd. 62.
folliculata, var. australis, Bailey, 62.
Forsteri, Wahl. 71.
Fridrichsthaliana, Steud. 69.
frigida, All. 63.
fulva, Gooden. 59.
furcata, Ell. 54.
fusca, All. 60, 62, 63.
fusiformis, Chapm. 33.
Fyllæ, Holm, 65.
gigantea, Boott, et al. 13?
gigantea, Kunth, 11.
gigantea, Rudge, 12.
glabra, Boott, 69.
glareosa, Wahl. 60.
glauca, Scopoli, 72.
glomerata, authors, 49.
glomerata, Thunb. 50.
gracillima, Schw. 71.
var. humilis, Bailey, 71.
gracillima × hirsuta, Bailey, 76.
Grahami, Boott, 38.
grandis, Bailey, 13.
granularioides, Schw. 72.
granularis, Muhl. 61, 70.
gravida, Bailey, 5.
C. Grayii, var. hispidula, Gray, 54.
grisea, Wahl. 61, 62.
var. angustifolia, Boott, 69, 70.
var. minor, Bœckl. 70.
var. ? rigida, Bailey, 56.
Grœnlandica, Lange, 65.
gynandra, Schw. 72.
gynocrates, Wormsk. 70.
hæmatolepis, Drejer, 27.
Hallii, Olney, 54.
heptastachya, Bœckl. 70.
hirsuta, Willd. 35.
var. pedunculata, Schw. & Torr. 76.
holostoma, Drejer, 64.
Hoodii, Boott, 14.
Hookeriana, Dewey, 14.
Howellii, Bailey, 45.
hyalina, Boott, 22.
hyalinolepis, Steud. 69.
hymenocarpa, Drejer, 38.
hyperborea, Boott, 65.
hystricina, Muhl. 61.
var. Dudleyi, Bailey, 54.
illota, Bailey, 15.
incurva, Lightf. 63, 66.
intermedia, Dewey, 8.
interrupta, var. impressa, Bailey, 18.
intumescens, Rudge, 62, 64, 72.
irregularis, Schw. 31.
inundata, Willd. 62.
Jamesii, Schw. 48.
Jamesii, Torr. 48, 49.
var. Nebraskensis, Bailey 48.
Jamesii, W. Boott, 19.
Jamesoni, Boott, 66.
Jonesii, Bailey, 16.
juncea, Willd. 62.
juncifolia, All. 63.
Kelloggii, W. Boott, 17.
Kelvingtoniana, Steud. 70.
Krausei, Bœckl. 70.
Kunzei, Olney, 75.
lacustris, Willd. 62.
lagopina, Wahl. 60, 65.
lagopodioides, Schk. 54, 62.
var. composita, Olney, 54.
var. cristata, Carey, 55.
f. glomerata, Olney, 54.

var. moniliformis, Olney, 56.
var. nana, Barratt, 77.
C. lanceata, Dewey, 45.
lanuginosa, Michx. 64.
latifolia, Wahl. 61.
laxiculmis, Schw. 47.
var. Floridana, Bailey, 47.
laxiflora, Lam. 31, 62.
var. divaricata, Bailey, 33.
var. styloflexa, Boott, 69, 72.
leiocarpa, Meyer, 69.
leiorhyncha, Meyer, 50.
lenticularis, Howell, 17.
lenticularis, Michx. 64.
lepidocarpa, Tausch, 28.
leporina, authors, 52.
leporina, Michx. 64.
var. Americana, Olney, 52.
leporina, var. bracteata, Liebm. 66.
leptalea, Wahl. 61.
leucocarpa, Bœckl. 71.
Liddoni, Boott, 21.
Liebmanni, Walpers, 66.
limula, Gray, 74.
limula, Olney, 18.
Lipsiensis, Peterm. 28.
litorosa, Bailey, 72.
littoralis, Petrie, 72.
littoralis, Schw. 72.
lonchicarpa, Willd. 62.
longicaulis, Bœckl. 70.
longirostris, Torr. 70.
lucorum, Willd. 61.
var. Emmonsii, Chapm. 40.
lupuliformis, Sartw. 13.
lupulina, Muhl. 11.
var. Bella-villa, Bailey, 12.
var. gigantoidea, Dewey, 13.
var. longipedunculata, Sartw. 12.
var. pedunculata, Dewey, 12.
var. polystachya, Schw. & Torr. 12, 13.
lupulina × retrorsa, Dudley, 13.
lurida, Bailey, 11.
lurida, Wahl. 10.
var. divergens, Bailey, 12.
var. flaccida, Bailey, 73.
var. gracilis, Bailey, 11.
lurida × lupulina, Bailey, 73.
C. lurida × retrorsa, Bailey, 13.
Macounii, Bennett, 45.
macrocephala, Willd. 62, 69.
macrochæta, Meyer, 68.
Macroklea, Steud. 69.
maculata, Boott, 66.
maculata, Liebm. 66.
Magellanica, Lam. 63, 64, 69.
marginata, Muhl. 61.
Marssoni, Auersw. 28.
media, R. Br. 68.
melanosperma, Liebm. 57, 66.
Mexicana, Presl. 69.
Michauxiana, Boeckl. 64, 72.
microglochin, Wahl. 60.
micropoda, Meyer, 70.
microsperma, Steud. 69.
microstachya, Michx. 64.
miliacea, Muhl. 61.
miliaris, Michx. 35.
var.? aurea, Bailey, 37.
var. obtusa, Bailey, 36.
var. major, Bailey, 36.
misandra, R. Br. 68.
var. elatior, Lange, 65.
miser, Buckley, 62, 78.
monile, Tuckm. 39, 72, 77.
var. colorata, Bailey, 39.
var. monstrosa, Bailey, 40.
var. Ræana, Bailey, 39.
monticola, Bœckl. 66.
Muhlenbergii, Schk. 62, 63.
var. enervis, Boott, 50.
multiflora, Muhl. 61.
muricata, Olney, 14.
muricata, var. Americana, Bailey, 14.
var. cephaloidea, Dewey, 5.
var. confixa, Bailey, 14.
var. gracilis, Boott, 14.
mutica, R. Br. 68.
Muskingumensis, Schw. 71.
nana, Cham. 69.
Nebraskensis, Dewey, 48.
var. prævia, Bailey, 49.
nigella, Boott, 47.
nigra, All. 63.
nigra, Olney, 10.
nigritella, Drejer, 65.
nigro-marginata, Schw. 67, 71.

C. nivalis, Cham. 70.
Norvegica, Willd. 21, 62.
nova, Bailey, 10.
Novæ-Angliæ, authors, 42.
Novæ-Angliæ, Schw. 44, 71, 78.
var. deflexa, Bailey, 43.
var. Emmonsii, Carey, 40.
var. Rossii, Bailey, 43.
nudata, var. angustifolia, Bailey, 16.
var. anomala, Bailey, 17.
obesa, var. minor, Boott, 61.
oblita, Steud. 69.
occidentalis, Bailey, 14.
ochroleuca, Cham. 37.
Œderi, authors, 31.
Œderi, Ehrh. 29.
Œderi, Syme, 30.
Œrstedii, Liebm. 67.
oligocarpa, Hornem. 70.
oligocarpa, Schk. 62, 70.
oligosperma, Michx. 64, 69.
olivacea, Boott, 66.
olivacea, Liebm. 66.
Orizabæ, Liebm. 67.
ovata, Rudge, 10.
oxylepis, Torr. & Hook. 70.
pachystachya, Cham. 51.
panicea, Linn. 72.
var. Canbyi, Olney, 53.
var. refracta, Olney, 7.
var. Woodii, Olney, 53.
paniculata, W. Boott. 50.
Parryana, var. unica, Bailey, 54.
patula, All. 63.
patula, Host, 29.
paupercula, Michx. 64.
pedata, Wahl. 60.
pedunculata, Muhl. 61.
pellita, Muhl. 61.
Pennsylvanica, Gray, 41.
Pennsylvanica, Lam. 61, 64, 70, 71, 72.
var. Muhlenbergii, Gray, 41.
var. nebulosa, Barratt, 77.
var. vespertina, Bailey, 74.
pertenuis, Bailey, 9.
physocarpa, Presl, 37.
physorhyncha, Steud. 67.
picta, Steud. 69.
C. pilosiuscula, Bœckl. 70.
pilulifera, var. deflexa, Drejer, 42.
pinetorum, Liebm. 23.
pinetorum, Willd. 62.
pinguis, Bailey, 25.
plantaginea, Lam. 64.
plantaginea, Michx. 64.
platyphylla, Carey, 64.
podocarpa, R. Br. 68.
podostachys, Steud. 69.
polygama, Schk. 62, 63.
polymorpha, W. Boott, 9.
polystachya, Wahl. 60.
polytrichoides, Muhl. 61, 64.
prasina, Muhl. 61, 69.
pratensis, 65.
Preslii, Steud. 52.
propinqua, Nees, 23.
protracta, Steud. 69.
Pseudo-Cyperus, Schw. 54, 71.
Pseudo-Cyperus, var. Americana, Hochst. 54, 71.
var. comosa, W. Boott, 54.
Pseudo-Cyperus × hystricina, Dudley, 54.
psilocarpa, Steud. 66.
ptychocarpa, Steud. 48.
var. macrophylla, Bailey, 48.
pubescens, Muhl. 61.
pulla, Gooden. 37.
var.? miliaris, Gray, 37.
Purshii, Olney, 11.
Pyrenaica, Wahl. 61, 70.
pyriformis, F. Schultz, 28.
Ræana, Boott, 39.
recta, Boott, 46.
recurva, Muhl. 71.
recurva, Schk. 71.
reducta, Drejer, 65.
refracta, Schk. 62.
retrocurva, Dewey, 47.
var. copulata, Bailey, 47.
retroflexa, Muhl. 57, 61.
retrorsa, Schw. 71.
var. minor, Boott, 8.
rhynchophysa, Liebm. 67.
Richardii, Michx. 64.
Richardsoni, R. Br. 68.
rigens, Bailey, 41, 67.

C. rigida, var. inferalpina, Drejer, 65.
riparia, Curtis, 62, 69.
Romanzoviana, Cham. 27.
rosea, Schk. 62, 69.
var. retroflexa, Torr, 57.
var. Texensis, Torr. 57.
Rossii, Boott, 43.
rostrata, Bailey, 60.
rostrata, Stokes, 59.
var. utriculata, Bailey, 59.
rostrata, Willd. 11.
rotundata, Gray, 37.
rotundata, Wahl. 39.
var. elatior, Lange, 65.
rufidula, Steud. 70.
rupestris, All. 63.
salina, Wahl. 45.
var. cuspidata, Wahl. 46.
var. minor, Boott, 46.
var. mutica, Wahl. 45.
var. robusta, Wahl. 45.
saltuensis, Bailey, 7.
Sartwelliana, Olney, 8.
Sartwellii, Dewey, 8.
Saskatchewana, Bœckl. 70.
saxatilis, Linn. 37.
var. Grahami, Hook. & Arn. 38.
var. major, Olney, 38.
var. miliaris, Bailey, 35.
scabrata, Schw. 71.
scabrella, Wahl. 60.
Schottii, Dewey, 44.
Schweinitzii, Dewey, 72.
scirpoidea, Michx. 64.
scirpoides, Schk. 58, 62.
scoparia, Schk. 62.
var. fulva, W. Boott, 21.
var. moniliformis, Tuckm. 56.
Scouleri, Torr. 25.
sempervirens, Schw. 71.
silicea, Olney, 24.
Smithii, Porter, 35.
spaniocarpa, Steud. 70.
sparganioides, Muhl. 61.
var. cephaloidea, Carey, 5.
specifica, Bailey, 21.
spreta, Bailey, 6.
squarrosa, Linn. 64.
stans, Drejer, 65.
C. stellulata, authors, 57, 58.
stenolepis, Torr. 70.
sterilis, Willd. 58, 61.
Steudelii, Kunth, 48.
stipata, Muhl, 61, 62.
stolonifera, Schw. 72.
straminea, Schk. 22.
straminea, Willd. 21.
vars., 21, 22, 23, 24.
var. australis, Bailey, 23.
var. brevior, Dewey, 22.
var. cumulata, Bailey, 23.
var. fœnea, Torr. 71.
var. hyalina, Boott, 22.
var. reniformis, Bailey, 73.
stramíniformis, Bailey, 24.
striata, Michx. 34.
var. brevis, Bailey, 34.
stricta, Bailey, 18.
stricta, Gooden. 17.
stricta, Hook. & Arn. 46.
stricta, Lam. 70, 71, 72.
var. Emoryi, Bailey, 70.
styloflexa, Buckley, 72, 78.
stylosa, Meyer, 65, 69.
var. virens, Bailey, 6.
subbiflora, Steudel, 70.
subcompressa, Steud. 69.
subspathacea, Wormsk, 65.
subulata, Michx. 64.
subuniflora, Steud. 70.
supina, Willd. 61, 70.
sylvatica, Huds. 63.
tenax, Reuter, 62.
tenera, Sartw. 21.
tentaculata, Muhl. 10.
var.? altior, Boott, 73.
var. gracilis, Boott, 11.
var. rostratà, Sartw. 73.
tentaculata × lurida, Bailey, 74.
tenuiflora, Wahl. 60.
tenuirostris, Bœckl. 15.
tenuirostris, Olney, 15.
tenuis, Rudge, 34.
tenuispica, Bœckl. 71.
teretiuscula, var. ampla, Bailey, 53.
tetanica, Schk. 63.
var. Canbyi, Porter, 53.
var. Carteri, Porter, 53.

var. Woodii, Bailey, 53.
C. tetrastachys, Scheele, 23.
Tolmiei, Boott, 46.
var. angusta, Bailey, 47.
var. nigella, Boott, 47.
var. subsessilis, Bailey, 47.
Torreyana, Schw. 72.
triangularis, Bœckl. 51.
tribuloides, Wahl. 54, 61, 62.
var. Bebbii, Bailey, 55.
var. cristata, Bailey, 55, 71.
var. reducta, Bailey, 56, 77.
var. turbata, Bailey, 55.
triceps, Michx. 34.
var. hirsuta, Bailey, 35.
var. Smithii, Porter, 34.
trichocarpa, Muhl. 61.
var. aristata, Bailey, 68.
trigona, All. 63.
tristicha, Bœckl. 71.
truncata, Bœckl. 33.
tuberculata, Liebm. 67.
Tuckermani, Dewey, 72.
turbinata, Liebm. 41, 67.
typhina, Michx. 64.
uetliaca, Sut. 28.
umbellata, Schk. 62.
Urbani, Bœckl. 70.
usta, Bailey, 20.
ustulata, Wahl. 60, 68.
utriculata, Boott, 59.
var. globosa, Olney, 60.
var. minor, Boott, 60.
vaginata, authors, 7.
varia, authors, 41.
varia, Muhl. 40.
var. colorata, Bailey, 41.
var. minor, Boott, 41, 42.
variabilis, Bailey, 18.
var. elatior, Bailey, 19.
C. variegata, Scheele, 72.
venusta, var. glabra, Bœckl. 69.
var. minor, Bœckl. 69.
verrucosa, Muhl. 62, 69, 70, 71.
vesicaria, Huds. 59.
vesicaria, var. alpigena, Fries, 39.
var. brachystachya, Barratt, 77.
var. dichroa, Anderss. 39.
var. globosa, Olney, 7.
var. gracilis, Barratt, 77.
var. lanceolata, Olney, 6.
var. major, Boott, 6.
vicaria, Bailey, 49.
var. costata, Bailey, 49.
virescens, Muhl. 61, 76.
var. costata, Dewey, 71, 76.
var. elliptica, Olney, 76.
var. minima, Barratt, 77.
Virginiana, var. elongata, Bœckl. 70.
viridula, Michx. 31.
viridula, Schw. & Torr. 34.
vulgaris, var. alpina, Boott, 46, 65, 68.
var. juncella, Olney, 17.
var. hyperborea, Boott, 64, 65, 69.
var. strictiformis, Bailey, 74.
vulpinoidea, Michx. 61, 64.
var. ambigua, Barratt, 78.
var. Drummondiana, Bœckl. 51.
var. glomerata, Barratt, 78.
var. platycarpa, Olney, 51.
Warmingii, Holm, 65.
Watsoniana, Steud. 70.
Whitneyii, Olney, 70.
Willdenovii, Schk. 48, 63, 69.
Woodii, Dewey, 53.
Xalapensis, Kunth, 50.
xanthophysa, Wahl. 61.
Yosemitana, Bailey, 8.

[Issued May 25th, 1889.]

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. I NO. 2.

Marine Algæ of the New Jersey Coast and adjacent Waters of Staten Island.

BY ISAAC C. MARTINDALE.

ISSUED AUGUST 24th, 1889.

PRICE, 50 CENTS.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

Vol. I. No. 2.

MARINE ALGÆ OF THE NEW JERSEY COAST AND ADJACENT WATERS OF STATEN ISLAND.

By Isaac C. Martindale, Camden, N. J.

(Read June 11, 1889).

The issue of Harvey's "Nereis Boreali Americana" in 1852–1857 by the Smithsonian Institute at Washington, was the first publication bearing on the marine algæ of the New Jersey coast; this does not show that collections were made much south of Long Branch. The fact was doubtless that up to that date very few persons indeed had collected on the more southern shores of the State. Samuel Ashmead, living at Beesley's Point, had during previous years made some study of the marine flora in his immediate vicinity, and there was published in the Report of "The Geology of the County of Cape May," issued in 1857, "A Catalogue of Marine Algæ discovered at Beesley's Point during the summer of 1855, by Samuel Ashmead, Esq." enumerating 29 species. Prof. W. G. Farlow issued in 1871–1872 a "List of the sea weeds or Marine Algæ of the south coast of New England." In 1875–1876 he also issued lists of the "Marine Algæ of the United States." In the Report of the U. S. Fish Commission for 1879, was issued "Marine Algæ of New England and adjacent coast," by Prof. Farlow; which is the best publication bearing directly on the marine flora of the New Jersey coast.

In the BULLETIN of the Torrey Botanical Club, July, 1886, Col. Nicholas Pike of Brooklyn published a "Check List of Marine Algæ, based on specimens collected on the shores of Long Island from 1839 to 1885." From time to time notes on

our marine flora have appeared in the same journal, but no attempt has been heretofore made to classify the collections on the New Jersey coast, except a bare list by A. B. Hervey in the "Preliminary Catalogue of the Flora of New Jersey," by N. L. Britton. F. S. Collins contributed to the December, 1888, No. of the BULLETIN an account of "Algæ from Atlantic City N. J. collected by S. R. Morse," giving a list of the species obtained from 1884 to 1888 inclusive.

The following list is based on the notes and collections of the writer, made during the past twenty years. Besides which Col. Pike has kindly furnished a list of "Algæ observed by Nicholas Pike on the New Jersey coast and collected by him between the years 1840 and 1886." Also a "List of the Marine Flora of Staten Island," prepared by himself. None of the specimens collected by him have been seen by me and are here given entirely on the authority stated. Prof. S. R. Morse of Atlantic City has collected very extensively in the waters of that section. The late Prof. Rachel L. Bodley of Philadelphia published some sketches in the columns of the "Public Ledger" of Philadelphia, on the collections made while spending a holiday season at Longport, six miles below Atlantic City. The first collections made at that place were by Mrs. H. M. Lawton, and Mrs. E. H. McCullough, who have proved themselves to be experts in the mounting of specimens, a number of which have been made into "souvenirs of Longport," and sold in the bazaars of Atlantic City and elsewhere. Miss A. R. Murphy of Germantown, Pa., subsequently collected quite extensively there, also at Atlantic City, and has been fortunate in obtaining some of the finest specimens yet seen on the coast. Miss Carrie A. Boice made a collection at Ocean Grove; Mrs. Nancy J. Gardner at Asbury Park; and Mrs. Lucy H. Porter, M.D., of Philadelphia, has made quite an extensive collection at Somer's Point and at Atlantic City. The late Halliday Jackson of West Chester, Pa., collected a few specimens at Cape May and other points of the coast. Dr. N. L. Britton has made considerable collections at Staten Island and about New York harbor; a number of other persons have from time to time added to the knowledge of our sea coast flora by their contributions. This list embraces 91 genera, 183 species and 41 varieties.

Nearly the whole of those collected in the waters about Atlantic City have been identified or examined either by Prof. Farlow or Frank S. Collins of Malden, Mass. The latter spent a few days at that point examining the collections of Prof. Morse, aud studying the finer forms found at the Inlet and Thoroughfare. The writer is greatly indebted to him for his generous and kindly aid, always furnished whenever called upon, and without which this list could not have been made as complete as it now is. The Geological Survey of New Jersey is to be congratulated that the valuable services of this eminent algologist have been thus obtained.

Among the microscopic forms of Marine Algæ some species may yet be detected on our shores, but the list embraces all the species known or said to have been collected on our coast. The herbarium of the Academy of Natural Sciences of Philadelphia has been examined in the preparation of this list; and the writer desires to return his sincere thanks to the numerous persons who have kindly allowed him to examine their collections, and to express the hope that this publication may be the means of awakening an interest in, or an incentive to a closer study of our flora by many of the thousands who spend some portion of the year at the numerous sea-side resorts of our State.

CRYPTOPHYCEÆ.

CHROOCOCCUS, Næg.

C. TURGIDUS, Næg. "Pier at Stapleton, S. I.; on rocks in brook near Silver Lake. Spring and summer" *Pike.*

XENOCOCCUS, Thuret.

X. SCHOUSBOEI, Thuret. Growing on *Lyngbya luteo-fusca.* Atlantic City, *Martindale.* Mr. Collins says, "this is the first time it has been reported on this coast."

GLŒOCAPSA (Kütz), Næg.

G. CREPIDINUM, Thuret.

On wharves, Atlantic City, *Morse, Martindale;* Staten Island, *Pike.*

ENTOPHYSALIS, Kütz.

E. GRANULOSA, Kütz. On old shells, Atlantic City, *Morse;* Mr. Collins says "not previously reported on the American coast."

POLYCYSTIS, Kütz.

P. PALLIDA, Kütz.

On decaying algæ. Atlantic City, *Morse.*

P. ELABENS, Kütz. "Prince's Bay, Staten Island," *Pike.*

CLATHROCYSTIS, Henfrey.

C. ROSEA-PERSICINA, Cohn.

On mud and small pebbles, Atlantic City, *Morse, Martindale;* Staten Island, *Pike.* It has occasionally been seen on fish in the Philadelphia market, which were said to have been caught on the New Jersey coast.

SPIRULINA, TURPIN.

S. TENUISSIMA, Kütz. Atlantic City, mixed with *Oscillaria,* etc., *Morse;* Swimming River, Monmouth Co., *Britton;* Staten Island, *Pike.*

BEGGIATOA, Trev.

B. ALBA, Trev.

Var. MARINA, Warming. On leaves and stems of *Spartina,* in brackish ditches, Atlantic City, *Martindale;* Staten Island, *Pike.*

B. ARACHNOIDEA, Rab.

With the former, Atlantic City, *Martindale.*

LEPTOTHRIX, Kütz.

L. RIGIDULA, Kütz. Growing on other algæ, Atlantic City, *Morse, Martindale.*

OSCILLARIA, Kütz.

O. SUBULIFORMIS, Harv. In brackish ditches and pools, Atlantic City, *Morse, Martindale;* Staten Island, *Pike.*

O. SUBTORULOSA (Brèb.), Farlow.

With the former, Atlantic City, *Morse, Martindale.*

O. LIMOSA, Kütz, var. CHALYBEA, Kütz. "Stapleton and Tompkinsville, Staten Island," *Pike.*

MICROCOLEUS, Desmaz.

M. CHTHONOPLASTES, (Fl. Dan.), Thuret. In brackish pools, Atlantic City, *Morse, Martindale.*

LYNGBYA, Ag.

L. MAJUSCULA (Dillw.), Harv. Cape Cod to Key West, common, *Farlow* in Mar. Alg. New England; Newark Bay, *Pike;*

Cape May, *Martindale.* On stems of floating *Zostera*, Atlantic City, *Morse.*

L. ÆSTUARII (Jürg.), Liebm. Salt ditches at Hoboken, *Prof. Bailey* in Ner. Bor. Am.; Perth Amboy, *F. Wolle ;* on floating *Zostera*, Atlantic City, *Morse ;* salt ditches, Cape May, *Martindale ;* common in salt ponds and marshes, Newark Bay, *Pike.*

L. LUTEO-FUSCA (Ag.), J. Ag. Hoboken and Staten Island, *Pike.* On wharves between tide marks, Atlantic City, *Martindale, Morse.*

L. TENERRIMA, Thuret. On wharves, Atlantic City, *Morse.*

L. NIGRESCENS, Harv. "Prince's Bay, Staten Island," *Pike.*

CALOTHRIX, Ag.

C. CONFERVICOLA (Roth), Ag. New York Bay, *J. Hooper* in "Introduction to Algology, with a catalogue of American Algæ," Brooklyn, 1850; Hoboken, Communipaw, Staten Island, *Pike.* On stems of *Fucus vesciculosus*, Atlantic City, *Morse, Martindale.*

C. CRUSTACEA (Schousb.), Born. and Thur. On stems of *Fucus, Morse, Martindale.*

C. SCOPULORUM (Web. and Mohr), Ag. Hoboken, Staten Island and Beesley's Point, *Pike ;* on wharves, Atlantic City, *Morse, Martindale.*

C. PULVINATA (Mert.), Ag. On wharves, Atlantic City, *Morse, Martindale.*

RIVULARIA (Roth), Ag.

R. ATRA, Roth. On stones, Atlantic City, *Martindale.*

R. POLYOTIS (J. Ag.), Bornet and Flahault. (*R. hospita*, Thuret.) On exposed roots of *Spartina*, Atlantic City, *Morse.*

R. NITIDA, Ag. (*R. plicata*, Carm.), "Prince's Bay, Staten Island," *Pike.*

ISACTIS, Thuret.

I. PLANA (Harv.), Thuret. On stones and old oyster shells, Atlantic City, *Morse, Martindale.*

BRACHYTRICHIA, Zau.

B. QUOYI (Ag.), Bornet and Flahault, (*Hormactics Quoyi*, Ag.). A specimen thought to be of this species was collected at Atlantic City, *Morse.*

ANABÆNA, Bory.

A. TORULOSA (Carm.), Lagerheim, (*Sphærozyga Carmichælii*, Harv.). Camden, *H. C. Wood, Jr.* in Fresh Water Algæ of America; on decaying algæ, Atlantic City, *Morse*, *Martindale*; Newark Bay, *Pike*.

NODULARIA, Mertens.

N. HARVEYANA, Thuret. "Mariners' Harbor, Staten Island," *Pike*.

ZOOSPOREÆ.

MONOSTROMA (Thuret), Wittr.

M. BLYTII (Aresch.), Wittr. A specimen thought to be of this species was collected on woodwork exposed to the waves, Atlantic City, *Morse*.

M. CREPIDINUM, Farlow. On wharf pilings, Atlantic City, *Morse*.

M. GREVILLEI (Thuret), Wittr. "Prince's Bay, Staten Island," *Pike*.

M. PULCHRUM, Farlow. "Common all around Staten Island," *Pike*.

ULVA (L.), Le Jolis.

U. LACTUCA (L.), Le Jolis. Common in bays along the whole coast.

Var. RIGIDA (Ag.), Le Jolis. Atlantic City, *Martindale*, *Morse*; Staten Island, *Pike*.

Var. LACTUCA, Le Jolis. Atlantic City, *Martindale*, *Morse*; Longport, *Mrs. Lawton*; Staten Island, *Pike*.

Var. LATISSIMA, Le Jolis. Common, Beesley's Point, *Ashmead*, and in bays along the whole coast. At Longport the fronds are often of unusual size; three feet long and fully as wide.

U. ENTEROMORPHA, Le Jolis. Common in bays along the whole coast, in a great variety of forms.

Var. LANCEOLATA, Le Jolis. Atlantic City, *Morse*, *Martindale*, *Miss A. R. Murphy*; Longport, *Lawton*; Staten Island, *Pike*.

Var. INTESTINALIS, Le Jolis. Asbury Park, *Mrs. N. T. Gardner*; Atlantic City, *Morse*, *Martindale*, *Murphy*; Longport, *Lawton*, *Mrs. E. H. McCullough*; abundant

in Little Bay, *Ashmead;* Beesley's Point, *Ashmead, Harvey;* Somer's Point, *Mrs. L. H. Porter;* Cape May, *Martindale.*

Var. COMPRESSA, Le Jolis. With the last named variety and equally abundant, growing on shells, stones and wood, between tide-marks.

U. MARGINATA (J. Ag.), Le Jolis. Atlantic City, *Morse,* on wharf between tide-marks.

U. AUREOLA, Ag. Atlantic City, *Morse, Collins.*

U. PERCURSA, Ag. Atlantic City, *Morse, Martindale,* on wharves, between tide-marks.

U. CLATHRATA, Ag. Beesley's Point, *Ashmead, Harvey;* Atlantic City, *Morse, Martindale;* Ocean Grove, *Miss Carrie A. Boice;* Longport, *Lawton;* New York Bay, *Pike.*

Var. UNCINATA, Le Jolis. Atlantic City, *Morse, Martindale.*

Var. ERECTA, Le Jolis. Atlantic City, *Morse, Martindale.*

Var. PROSTRATA, Le Jolis. Atlantic City, *Morse, Martindale.*

Var. CRINITA, Hauck. (*Enteromorpha crinita,* J. Ag.). Atlantic City, *Martindale.*

All these varieties grow on shells and stones between tide-marks.

U. HOPKIRKII (McCalla), Harv. Staten Island, *Pike;* Atlantic City, on old shells, *Morse, Martindale.*

ULOTHRIX (Kütz.), Thur.

U. FLACCA (Dillw.), Thur. On wharves, Atlantic City, *Martindale, Morse.*

U. ISOGONA (Engl. Bot.), Thuret. New York Bay, *Harvey;* Common at Fort Hamilton in spring, *Harvey;* on wharves, Atlantic City, *Morse, Martindale;* Staten Island, *Pike.*

Mr. Morse collected at Atlantic City a very slender form, which Mr. Collins states may possibly be distinct from either of these species.

CHÆTOMORPHA, Kütz.

C. ÆREA (Dillw.), Kütz. New York Bay, *Hooper,* in Harvey Ner. Bor. Am.; common at Beesley's Point, *Pike.*

C. PICQUOTIANA (Mont.), Kütz. Staten Island, *Torrey* in

Harvey, Ner. Bor. Am.; Communipaw, Prince's Bay, S. I. and Long Branch, *Pike;* washed ashore at Atlantic City, *Martindale, Murphy.*

C. LINUM (Flor. Dan.), Kütz. Staten Island, *Pike;* Atlantic City, *Martindale, Morse;* washed ashore at Longport, *McCullough;* at Beesley's Point, *Ashmead.* In the summer of 1887 I collected at Somer's Point a form with unusually large fronds, which must be of this species although the cells were very much larger than common. Intermediate forms also occur.

C. MELAGONIUM (Web. and Mohr), Kütz. Atlantic City, *Morse, fide Collins.* A slender short-jointed form, probably due to the locality being at the extreme southern range of this species.

RHIZOCLONIUM, Kütz.

R. SALINUM (Schleich.), Kütz. (*R. riparium,* Roth.). On exposed *Spartina* roots, Atlantic City, *Martindale, Morse.*

R. KOCHIANUM, Kütz. On *Zostera,* Atlantic City, *Martindale;* Somer's Point, *Porter.*

R. TORTUOSUM, Kütz. "Prince's Bay, S. I.," *Pike.*

CLADOPHORA, Kütz.

C. ARCTA (Dillw.), Kütz. New York Bay, *Walters,* in Harv. Ner. Bor. Am.; common on south shore of Staten Island, *Pike.*

C. LANOSA (Roth.), Kütz. "Prince's Bay, S. I.," *Pike.*

C. RUPESTRIS, Kütz. "Communipaw and Prince's Bay, S. I.," *Pike.*

C. ALBIDA (Huds.), Kütz. Staten Island, New York Bay, Beesley's Point, Cape May, *Harvey,* Ner. Bor. Am.; Communipaw, *Pike;* Atlantic City, *Morse.*

C. REFRACTA (Roth), Aresch. New York, *Harvey,* Ner. Bor. Am.; South Beach, S. I., *Britton;* Atlantic City, *Morse;* floating in the bay at Longport, *Lawton;* Newark Bay, *Pike.*

C. GLAUCESCENS (Griff.), Harv. New York Bay, *Harvey,* Ner. Bor. Am.; Beesley's Point, *Ashmead;* Atlantic City, *Morse;* Staten Island, *Pike.*

C. LÆTEVIRENS (Dillw.), Harv. New York Bay, *Harvey,*

Ner. Bor. Am ; Communipaw, Staten Island, Beesley's Point, *Pike.*

C. HUTCHINSIÆ (Dillw.), Kütz. In tide pools, Atlantic City, *Morse, Martindale, Murphy;* Longport, *McCullough, Lawton, Miss Jennie Hood.*

C. FLEXUOSA (Griff.), Harv. In tide pools, Atlantic City, *Martindale, Morse*; Longport, *Lawton.*

C. MORRISIÆ, Harv. Elsinborough, Delaware, *Miss Morris,* in Harvey, Ner. Bor. Am. This may be a typographical error, as there is an Elsinborough in Salem Co. N. J.

C. RUDOLPHIANA (Ag.), Harv. Communipaw and Pleasure Bay, and Prince's Bay, S. I., *Pike.*

C. GRACILIS (Griff.), Kütz. Beesley's Point, *Ashmead*; New York Bay, *J. Hooper*; brackish pond at New Dorp, Staten Island, *Britton*; Atlantic City, *Morse, Martindale, Murphy*; Longport, *Lawton* ; Asbury Park, *Gardner.*

Var. EXPANSA, Farlow. Atlantic City, *Morse.*

C. EXPANSA, Kütz. In brackish pools, Atlantic City, *Morse, Martindale*; Longport, *McCullough.*

C. FRACTA (Fl. Dan.), Kütz. New York, *Harvey*; in the Hudson, near West Point, *Bailey*; Beesley's Point, *Ashmead*; Atlantic City, *Morse*; floating at Key East, *Gardner*; Staten Island, *Pike.*

C. FALCATA, Harv. "Occurs plentiful in Little Bay, Cape May Co.," *Ashmead.* This may be only *C. gracilis.*

A quantity of the new genus *Acroblaste,* Reinsch, Farlow, Mar. Alg. New Eng., p. 57, the species not determined, has been collected at Atlantic City, *Morse, Martindale.*

BRYOPSIS, Lamourx.

B. PLUMOSA (Huds.), Ag. Attached to old shells and other submerged substances on the shores of Great Egg Harbor Bay, *Ashmead;* New York Bay, *Chamberlin;* Staten Island, *Torrey Herb.;* common near New York, *Harvey, Pike;* in muddy ditches, Atlantic City, *Morse, Martindale;* Longport, *Murphy, Martindale, Miss Hood.*

B. HYPNOIDES, Lamourx. "On the ferry bridge, Jersey City, just below the water line, 1850," *Pike.* Not otherwise known in our waters.

DERBESIA, Sol.

D. TENUISSIMA (De Not.), Crouan. South shore of Staten Island, *Britton*, *Pike*.

PHYLLITIS (Kütz.), Le Jolis.

P. FASCIA (Fl. Dan.), Kütz. Fort Hamilton, New York Harbor, *Pike* in Harvey Ner. Bor. Am.; also collected by *Col. Pike* at Long Branch; Atlantic City, *Morse*, *Martindale;* Longport, *Lawton*.

Var. CÆSPITOSA. Atlantic City, *Morse*, *Martindale*.

SCYTOSIPHON (Ag.), Thur.

S. LOMENTARIUS (Lyngb.), J. Ag. British America to Charleston, S. C., *Harvey;* on stones between tide-marks, Atlantic City, *Morse;* Staten Island, *Pike*.

PUNCTARIA, Grev.

P. LATIFOLIA, Grev. Fort Hamilton, New York, *Harvey;* Perth Amboy, *Harvey*, *Britton;* Atlantic City, *Morse*, *Martindale;* Staten Island, *Pike*.

Var. ZOSTERÆ, Le Jol. Fort Hamilton, N. Y., *Harvey*, *Pike;* Communipaw, *Pike;* Atlantic City, *Morse*, *Martindale;* Longport, *Lawton*.

P. PLANTAGINEA (Roth), Grev. On piling between tide-marks, Atlantic City, *Morse*, *Martindale*.

DESMARESTIA, Lamourx.

D. ACULEATA (L.), Lamourx. Communipaw, Staten Island and Beesley's Point, *Pike*.

D. VIRIDIS (Fl. Dan.), Lamourx. New York Bay, *J. Hooper;* common in Prince's Bay, Staten Island, Pleasant Bay and at Sandy Hook, *Pike*.

DICTYOSIPHON, Grev.

D. FŒNICULACEUS (Huds.), Grev. On stones and on other algæ near low water mark, Atlantic City, *Morse;* Longport, *Lawton;* New York Bay, *J. Hooper;* common at Prince's Bay, Staten Island, *Pike*. Variable, some forms approaching var. *flaccidus*, Aresch., were collected at Atlantic City, *Morse*.

MYRIOTRICHIA, Harv.

M. CLAVÆFORMIS, Harv. Communipaw, Staten Island and Pleasure Bay, *Pike;* on *Zostera*, Atlantic City, *Martindale*, *Morse;* Longport, *Martindale*, *McCullough*.

Var. FILIFORMIS, Farlow. With the type.

ECTOCARPUS, Lyngb.

E. TOMENTOSUS (Huds), Lyngb. Atlantic City, *Morse.*

E. GRANULOSUS (Eng. Bot.), Ag. Atlantic City, on an old mast, *Morse.*

Var. TENUIS, Farlow. Atlantic City, *Martindale.*

E. CONFERVOIDES (Roth), Le Jolis. Occurs sparingly on shores of Little Bay, on rockweed, *Ashmead;* New York Bay, *Hooper;* south shore of Staten Island, *Britton, Pike;* Atlantic City, *Morse, Martindale;* Longport, *Murphy, McCullough, Dr. Porter.*

Var. SILICULOSUS, Kjellman. Common in the bays on *Zostera*, disappearing in July, Beesley's Point, *Ashmead;* on *Spartina* roots in tide pools, Atlantic City, *Martindale, Morse;* Ocean Grove, *Boice;* Longport, *Lawton.*

E. FASCICULATUS, Harv. Communipaw, Prince's Bay, Staten Island and Perth Amboy, *Pike.*

E. LUTOSUS, Harv. Staten Island and Pleasure Bay, *Pike.*

E. LITTORALIS, Lyngb. Abundant in the bays of Egg Harbor, *Ashmead;* south shore of Staten Island, *Britton, Pike;* Atlantic City, *Morse, Martindale, Murphy;* on wood work exposed to the waves, Longport, *Martindale, Lawton.*

Var. RAMELLOSUS, Hauck. Atlantic City, *Collins, Morse.*

E. TERMINALIS, Kütz. Atlantic City, *Martindale, Morse.*

SPHACELARIA, Lyngb.

S. CIRRHOSA (Roth), Ag. Shore of Staten Island, on *Cystoclonium, Britton;* also reported by *Pike.*

CLADOSTEPHUS, Ag.

C. VERTICILLATUS (Lightf.), Ag. Staten Island, *Pike.*

MYRIONEMA, Grev.

M. VULGARE, Thur. Common on various algæ and occasionally found on stones along the entire New Jersey coast, *Pike;* on *Ulva*, Atlantic City, *Martindale, Morse.*

ELACHISTEA, Duby.

E. FUCICOLA (Velley), Fries. Common along Staten Island, *Pike;* on *Fucus*, Atlantic City, *Morse, Martindale;* Longport, *Martindale, McCullough.*

LEATHESIA, S. F. Gray.

L. DIFFORMIS (L.), Aresch. Staten Island, *Pike*; on wood work at low water mark, Atlantic City, *Morse, Martindale;* sometimes on other algæ, Longport, *Lawton, McCullough.*

CHORDARIA, Ag.

C. FLAGELLIFORMIS (Fl. Dan.), Ag. Staten Island, *Harvey* Ner. Bor. Am., *Pike;* Atlantic City, *Morse.*

MESOGLOIA, Ag.

M. DIVARICATA (Ag.), Kütz. Very common from Cape Cod southward, *Farlow;* New York Bay, *Hooper;* Pleasure Bay, *Pike.*

CASTAGNEA (Dub. and Sol.), Thur.

C. VIRESCENS (Carm.), Thur. A specimen of this species is said to have been collected on the beach at Long Branch; if so, it must have been washed in by the waves from the coast of New England.

RALFSIA, Berkeley.

R. VERRUCOSA (Aresch.), J. Ag. On old shells, Atlantic City, *Martindale, Porter.*

R. CLAVATA (Carm.), Crouan. Atlantic City, *Morse, Martindale;* Longport, *Martindale;* Somer's Point, *Porter.*

ASPEROCOCCUS, Lamourx.

A. ECHINATUS (Mert.), Grev. "All around Staten Island." *Pike.*

STILOPHORA, J. Ag.

S. RHIZODES, Ag. Egg Harbor, rather rare on old shells, near low water mark, *Ashmead;* Staten Island, *Pike.*

S. PAPILLOSA, J. Ag. "Great Egg Harbor Bay and Pleasure Bay," *Pike.* Not otherwise known on our coast; possibly only a form of the former species.

STRIARIA, Grev.

S. ATTENUATA, Grev. "Prince's Bay, S. I.," *Pike.* See Farlow, Mar. Alg. p. 90.

CHORDA, Stack.

C. FILUM (L.), Stack. Perth Amboy, *Hervey, Britton;* Ocean Beach, *C. Henry Kain.*

LAMINARIA, Lamourx.

L. SACCHARINA (L.), Lamourx. "Cast up from deep water on

the New Jersey coast, its southern limit not ascertained below Long Branch," *Harvey*; on the beach at Asbury Park in great abundance in 1887, *N. T. Gardner*; Atlantic City, *Morse*; and occasionally at Longport, *Martindale*; New Dorp, S. I., *Britton*.

L. DIGITATA (L.), Lamourx. "Prince's Bay, S. I.," *Pike*.

ALARIA, Grev.

A. ESCULENTA, Grev. "Found only once at Prince's Bay, S. I., probably washed from Montauk Point, much decomposed, end of summer," *Pike*.

OOSPOREÆ.

ASCOPHYLLUM (Stack), Le Jolis.

A. NODOSUM (L.), Le Jolis, (*Fucus nodosus*, L.). New York Bay, shores of Staten Island, *Pike*; Atlantic City, *Morse*, *Martindale*; Longport, washed up in great abundance in 1887, *Martindale*; sparingly in 1888, *McCullough*; Sandy Hook, *Britton*.

FUCUS (L.), Decne. & Thur.

F. VESICULOSUS, L. Common on the whole coast; the fronds very variable.

Var. LATERIFRUCTUS, Grev. With the type.

Var. SPIRALIS. With the type.

F. EDENTATUS, De La Pylaie? (*F. evanescens* of Farlow Marine Algæ N. E.) Atlantic City, *Morse*, *Collins*.

F. CERANOIDES, L. "Sailors' Snug Harbor, S. I.," *Pike*.

SARGASSUM, Ag.

S. VULGARE, Ag., frequently washed ashore along the entire coast.

Var. MONTAGNEI, Atlantic City, *Martindale*, *Morse*; quite abundant at Longport in 1887, *McCullough*, *Porter*, *Martindale*; also at Somer's Point, *Porter*.

S. BACCIFERUM (Turn.), Ag. Frequently washed ashore, Atlantic City, *Martindale*; Longport, *McCullough*, *Bodley*.

VAUCHERIA, D.C.

V. THURETII, Woronin. Muddy ditches, Atlantic City, *Morse*.

V. LITOREA (Hoffman), Bang. On gravel stones, Atlantic City, *Morse*, *Martindale*.

FLORIDEÆ.

TRENTEPOHLIA (Ag.), Prings.

T. VIRGATULA (Harv.), Farlow. On other algæ and on *Zostera*, Atlantic City, *Morse*, *Martindale*; Longport, *Lawton*.

T. DAVIESII (Dillw.), Harv. On *Chætomorpha Melagonium*, Atlantic City, *Morse, fide Collins*.

PORPHYRA, Ag.

P. LACINIATA (Lightf.), Ag. (*P. vulgaris, Harv.*). Common along the shores of New York Bay and Harbor. On *Zostera* in Little Bay, Egg Harbor, very rare, *Ashmead*; Atlantic City, *Morse*, *Martindale*; Longport, *Lawton*, *McCullough*, *Martindale*.

P. LEUCOSTICTA, Thur. Atlantic City, *Morse*, vide F. S. Collins in Bull. Torrey Bot. Club, xi. 132; Longport, *Lawton, McCullough, Martindale*.

BANGIA, Lyngb.

B. FUSCO-PURPUREA (Dillw.), Lyngb. On wharves, Atlantic City, *Morse, Martindale, Murphy*; Staten Island and Pleasure Bay, *Pike*.

ERYTHROTRICHIA, Aresch.

E. CERAMICOLA (Lyngb.), Aresch. Atlantic City, *Morse*, *Martindale*, *Murphy*; Longport, *Martindale*, *McCullough*.

E. CILIARIS (Carm.), Thuret. In company with *Trentepohlia Daviesii*, Atlantic City, *Morse, fide Collins*. Has not been previously reported on the coast from any point north of South Carolina.

GONIOTRICHUM, Kütz.

G. ELEGANS (Chauv.), Zanard. Atlantic City, *Morse*, mixed with *Bangia*; detected by F. S. Collins.

HILDENBRANDTIA, Nardo.

H. ROSEA, Kütz. "Very common on stones from Hoboken to Sandy Hook, *Pike*."

SPERMOTHAMNION, Aresch.

S. TURNERI (Mert.), Aresch. "Communipaw and Staten Island," *Pike*.

CALLITHAMNION, Lyngb.*

*C. ROTHII (Engl. Bot.), Lyngb. Common from New York northward, *Farlow* in Mar. Algæ New Eng., but so far as I know has not definitely been detected in New Jersey waters.

C. CRUCIATUM, Ag. Red Hook, New York, *Harvey* Ner. Bor. Am.; Communipaw and Staten Island, *Pike;* Atlantic City, *Morse, Martindale;* Longport, *Lawton, McCullough, Murphy, Martindale.* The rare cystocarpic fruit is quite common at Atlantic City, *Collins.*

C. AMERICANUM, Harv. From New Jersey northward, *Farlow;* on the New Jersey Flats and on Staten Island, *Pike;* Atlantic City, *Morse, Martindale.*

C. PLUMULA (Ellis), Lyngb. Long Branch, *Miss E. C. Morris* in Harvey Ner. Bor. Am.; Staten Island and Communipaw, *Pike;* Atlantic City, *Morse.*

C. BORRERI (Engl. Bot.), Harv. New York, *Harvey;* very common at Sailors' Snug Harbor, Staten Island and Communipaw, *Pike;* Atlantic City, *Morse, Martindale, Porter, Murphy;* Longport, *Lawton, McCullough, Miss J. Hood, Martindale, Murphy;* Somer's Point, *Porter;* Cape May, *Halliday Jackson, Martindale.*

C. ROSEUM (Roth), Harvey. New York Harbor, *A. R. Young* in Farlow Marine Algæ New Eng; Prince's Bay, Staten Island, and Pleasure Bay, *Pike;* Atlantic City, *Morse, Collins, Martindale.*

C. POLYSPERMUM, Ag. Rare on old shells in Great Egg Harbor Bay, *Ashmead;* Staten Island and Communipaw, *Pike.*

C. TETRAGONUM (With.), Ag. Fort Hamilton and Red Hook, New York Bay, and it probably grows on the New Jersey shore, *Pike.*

C. BAILEYI, Harv. Common from New Jersey to Cape Cod, *Farlow;* New Brighton, S. I. and abundant in New York Bay, *Harvey;* common at Staten Island, *Pike.*

C. BYSSOIDEUM, Arn. New York Harbor, *Harvey;* Port Richmond and New Brighton S. I., *B. B. Chamberlain, Pike;* frequent on *Zostera* and attached to old shells in Great Egg Harbor Bay, *Ashmead;* Atlantic City, *Martindale, Morse, Murphy;* Jersey City and Hoboken, *H. Jackson;* Longport, *Lawton, McCullough, Martindale, Murphy;* Somer's Point, *Porter;* Cape May, *Martindale.* The forms

of this species are numerous, but the definite varieties have not been separated.

C. CORYMBOSUM (Engl. Bot.), Lyngb. "Communipaw and Staten Island," *Pike.*

C. DIETZLÆ, Hooper. "Communipaw and Staten Island," *Pike.* This may be incorrectly determined, see Farlow's Manual, page 9.

C? TENUE (Ag.), Harv. Beesley's Point, Cape May Co., *Ashmead* in Harvey Ner. Bor. Am.; Pleasure Bay, Communipaw, and at Stapleton, *Pike;* Atlantic City, *Morse, Martindale;* Longport, *Lawton, McCullough;* Somer's Point, *Dr. Porter.* All the specimens found thus far are sterile, so that the true genus still remains unsettled.

GRIFFITHSIA, Ag.

G. BORNETIANA, Farlow. Communipaw, Staten Island and Pleasure Bay, *Pike.*

HALURUS, Kütz.

H. EQUISETIFOLIUS, Kütz. "New Jersey coast near New York," *Pike.* According to Farlow's Manual this must be very doubtful.

PTILOTA, Ag.

P. ELEGANS, Bonnem. Squan Beach, N. J., *Miss Morris* in Harvey, Ner. Bor. Am; Sandy Hook, *Pike;* very large specimens at Sea Bright, 1883, *H. Averill;* Ocean Grove, *C. A. Boice;* Asbury Park, *Louisa Emily Knight;* Atlantic City, *Morse, Martindale;* Longport, *Lawton, McCullough.*

P. PECTINATA (Gunnar), Kjellman. (*P. serrata,* Kütz.) Asbury Park, *Louisa Emily Knight,* 1886. The only specimen so far as known coming from N. J. waters.

CERAMIUM, Lyngb.

C. RUBRUM (Huds.), Ag. Cape Cod to Charleston, *Harvey;* New York harbor, *H. Jackson, N. Pike;* abundant on *Zostera* and quite variable, Beesley's Point, *Ashmead;* Atlantic City, *Morse, Martindale, Murphy, Porter;* abundant on south shore of Staten Island, *Britton;* Ocean Grove, *C. A. Boice;* Somer's Point, *Porter;* Longport, *Lawton, McCullough, Martindale, Murphy.*

Var. PROLIFERUM, J. Ag. Asbury Park, *N. T. Gardner*; Atlantic City, *Martindale.*

Var. SECUNDATUM, Ag. Atlantic City, *Martindale.*

Var. SQUARROSUM, Harv. Atlantic City, *Martindale.*

C. CIRCINNATUM, Kütz. "Prince's Bay, S. I., Aug. and Sept." *Pike.*

C. DIAPHANUM (Lightf.), Roth. Sparingly, Beesley's Point, *Ashmead*; Atlantic City, *Morse, Martindale*; Longport, *Lawton, McCullough, Murphy.*

C. STRICTUM (Kütz.), Harv. Common from New York to Cape Cod, *Farlow*, Mar. Alg. New Eng.; Communipaw and Pleasure Bay, *Pike*; Asbury Park, *C. H. Kain*; Ocean Grove, *C. A. Boice*; Atlantic City, *Morse, Martindale, Murphy, Porter*; Longport, *Lawton, McCullough, Martindale*; Somer's Point, *Porter*; Cape May, *H. Jackson.*

C. FASTIGIATUM, Harv. New York Bay, *Chamberlin, Pike*; Long Branch, *Miss Morris* in Harvey Ner. Bor. Am.; in dense tufts on *Zostera*, rather rare, Beesley's Point, *Ashmead*; Atlantic City, *Morse, Martindale*; Asbury Park, *N. T. Gardner*; Somer's Point, on *Rhabdonia, Martindale, Porter.*

C. TENUISSIMUM (Lyngb.), J. Ag. Staten Island, *Pike*; Ocean Grove, *C. H. Kain, C. A. Boice*; Asbury Park, *N. T. Gardner*; Atlantic City, *Morse, Martindale*; Longport, *Lawton, McCullough, Martindale.*

Var. ARACHNOIDEUM, J. Ag. Atlantic City, *Martindale.*

Var. PATENTISSIMUM, Harv. Atlantic City, *Morse, Martindale.*

SPYRIDIA, Harv.

S. FILAMENTOSA (Wulf.), Harv. Common from Cape Cod southward, *Farlow*; abundant in bays at Egg Harbor, *Ashmead*; Staten Island and Communipaw, *Pike*; Atlantic City, *Morse, Martindale*; Longport, *Martindale, McCullough.*

PHYLLOPHORA, Grev.

P. BRODIÆI (Turn.), J. Ag. Communipaw and Prince's Bay, *Pike*; Asbury Park, *N. T. Gardner*; Atlantic City, *Morse, Martindale.*

P. MEMBRANIFOLIA (Good. & Woodw.), J. Ag. New York, *Hooper*, *Calverly* in Harvey Ner Bor. Am.; Long Branch, *Miss Morris* in same; Staten Island and Pleasure Bay, *Pike*; Asbury Park and Ocean Beach, *N. T. Gardner*; Ocean Grove, *C. A. Boice*; Atlantic City, *Morse*, *Martindale*.

GYMNOGONGRUS, Mart.

G. TORREYI (Ag.), J. Ag. New York, *Prof. Agardh*; Staten Island, *Pike*.

AHNFELDTIA, Fries.

A. PLICATA (Huds.), Fries. New York, *Calverly* in Harvey Ner. Bor. Am.; Staten Island and Sandy Hook, washed ashore, *Pike*.

CYSTOCLONIUM, Kütz.

C. PURPURASCENS (Huds.), Kütz. Squan, *Miss E. Morris* in Harvey Ner. Bor. Am.; New York Bay, *J. Hooper*; abundant on south shore of Staten Island, *Britton*; Atlantic City, *Morse*, *Martindale*.

Var. CIRRHOSA, Harv. Ocean Grove, *C. A. Boice*.

GIGARTINA, Lamourx.

G. MAMILLOSA (Good. & Woodw.). J. Ag. "Prince's Bay, S. I.," *Pike*.

CHONDRUS, Stack.

C. CRISPUS (L.), Stack. Collected at Staten Island in 1860 by *John Hooper*, according to Col. N. Pike; Atlantic City, *Morse*.

RHODYMENIA (Grev.), J. Ag.

R. PALMATA (L.), Grev. On *Laminaria* at Long Branch, *Pike*; Atlantic City, *Morse*.

EUTHORA, J. Ag.

E. CRISTATA, J. Ag. Staten Island, *Farlow*, Marine Alg. New Eng.; Prince's Bay, S. I., *Pike*; Long Branch, *J. Walters*, *J. Hooper*.

LOMENTARIA (Gaill.), Thuret.

L. UNCINATA, Menegh. Common from Cape Cod southward, *Farlow*; Staten Island, *Pike*; frequent on *Zostera* and *Ulva*, Beesley's Point, *Ashmead*; Somer's Point, *Porter*, *Martindale*; Atlantic City, *Morse*, *Martindale*, *Murphy*; Longport, *Lawton*, *Murphy*, *McCullough*.

Var. FILIFORMIS, Harv. Atlantic City, *Morse, Martindale*; Longport, *Lawton, McCullough, Martindale*, and an extreme form, possibly var. *robusta*, Harvey.

Var. VALIDA (Harv.) Longport, *Martindale.*

L. ROSEA (Harv.), Thuret. "Stapleton, S. I.," *Pike.*

CHAMPIA, Ag.

C. PARVULA (Ag.), Harv. Common from Cape Cod southward, *Farlow*; plentiful in Little Bay, *Ashmead*; Staten Island, *Pike*; Asbury Park, *Gardner*; Ocean Grove, *C. A. Boice, C. H. Kain*; Atlantic City, *Morse, Martindale, Murphy, Porter*; Longport, *Lawton, McCullough, Martindale, Murphy*; Somer's Point, *Porter, Martindale.*

HYPNEA, Lamourx.

H. MUSCIFORMIS (Wulf.), Lamourx. Sandy Hook, *Pike*; washed ashore, Atlantic City, *Murphy*; Longport, *Lawton.*

GELIDIUM, Lamourx.

G. CRINALE (Turn.), J. Ag. Red Hook, N. Y., *Harvey*; on old shells in Little Bay, Egg Harbor, *Ashmead*; New York Bay, *J. Hooper*; Communipaw, *J. Walters, Pike*; on piling below high water, Atlantic City, *Morse, Martindale*; Somer's Point, *Martindale, Porter.*

RHABDONIA, Harv.

R. TENERA, Ag. Common on shores of Staten Island, *Chamberlin*; Long Branch, *Miss Morris* in Harvey Ner. Bor. Am.; very common on shores at Egg Harbor Bay, *Ashmead*; Somer's Point, *Porter*; Atlantic City, *Morse, Martindale, Murphy*; Longport, *Lawton, McCullough, Murphy, Martindale*; Cape May, *Martindale, H. Jackson, Miss H. C. Bond*; Ocean Grove, *Gardner, Miss Boice*; on all shores about New York Harbor, *Pike.*

POLYIDES, Ag.

P. ROTUNDUS (Gmel.), Grev. Growing on rocks near Stapleton, south shore of Staten Island, *Pike.*

GRINNELLIA, Harv.

G. AMERICANA (Ag.), Harv. New Brighton and New Dorp, Staten Island, *Britton, Pike*; Fort Hamilton, *Chamberlin*; a single specimen in Great Egg Harbor Bay, *Ashmead*; Ocean Grove, *C. A. Boice*; Asbury Park, *Gardner, L. E.*

Knight; Atlantic City, *Morse, Martindale, Miss Ray S. Comly, Murphy;* Longport, *Lawton, McCullough, J. Hood, Martindale, Miss Murphy,* who collected in the summer of 1888 some of the finest specimens ever seen on our coast.

DELESSERIA, Lamourx.

D. SINUOSA (Good. and Woodw.), Lamourx. Long Branch and at Prince's Bay, S. I., *Pike;* Sea Bright, *Horace Averill;* Ocean Grove, *C. A. Boice;* Atlantic City, *Morse.*

D. ALATA (Huds.), Lamourx. "Stapleton, S. I.," *Pike.*

D. LEPRIEURII, Mont. Fort Lee, N. Y., *Horace Averill,* etc., in Farlow Mar. Alg. New Eng; Atlantic City, on piling, *Morse, Martindale;* Longport, *Martindale.*

GRACILARIA, Grev.

G. MULTIPARTITA, J. Ag. Common from Cape Cod southward, *Farlow;* shores of Staten Island, *Chamberlin, Pike;* Long Branch, *Miss Morris;* Atlantic City, *Morse, Martindale, Murphy, Porter;* Longport, *Lawton, McCullough, Murphy, Martindale;* Somers Point, *Porter;* plentiful in Egg Harbor Bay, particularly on planted oysters, *Ashmead;* frequent in New York Bay, *Hooper.*

Var. ANGUSTISSIMA, Harv. Same localities, but less abundant. Cape May, *Martindale.*

CHONDRIOPSIS, J. Ag.

C. DASYPHYLLA (Woodw.), J. Ag. Plentiful in Little Bay and on Bond's Bar, growing in large tufts on sandy mud, *Ashmead;* Staten Island, *Pike;* Atlantic City, *Martindale;* Longport, *McCullough, Murphy, Martindale.*

C. TENUISSIMA (Good. and Woodw.), J. Ag. Common with the last, Egg Harbor, *Ashmead;* Asbury Park, *Gardner;* Atlantic City, *Morse, Martindale, Murphy;* Longport, *Lawton, McCullough, Martindale, Murphy;* Somer's Point, *Porter, Martindale;* Staten Island, *Pike.*

Var. BAILEYANA, Farlow. Atlantic City, Longport and Somer's Point, same collectors; New York Harbor, *Prof. Bailey, Pike;* Fort Hamilon, *H. Jackson.*

C. ATROPURPUREA (Harv.), J. Ag., var. FASCICULATA, Farlow. Fort Hamilton, N. Y., *Harvey,* Farlow Mar. Alg. New Eng.; Prince's Bay, S. I. and Pleasure Bay, *Pike.*

RHODOMELA, Ag.

R. SUBFUSCA (Woodw.), Ag. Staten Island, *Harvey*; New York Bay, *Hooper*; Prince's Bay, Staten Island, *Britton, Pike.*

Var. GRACILIOR, J. Ag. "South shore of Staten Island, April and May," *Pike.*

POLYSIPHONIA, Grev.

P. URCEOLATA (Dillw.), Grev. From New Jersey northward, *Farlow*; Long Branch, *Miss Morris*, in Harvey Ner. Bor. Am.; Atlantic City, *Morse, Martindale, Murphy*; Staten Island, *Pike.*

Var. FORMOSA, Ag. Fort Hamilton, etc., in New York Bay, *Harvey*; Cape May, *H. Jackson*; Atlantic City, *Morse.*

P. SUBTILISSIMA, Mont. Hoboken, 1861, *J. Hooper*; Communipaw and Staten Island, *Pike.*

P. OLNEYI, Harv. On *Zostera* in Egg Harbor Bay, *Ashmead*; very abundant in Pleasure Bay in August and September, *Pike*; Ocean Beach, *C. H. Kain*; Atlantic City, *Martindale, Morse*; Cape May, *H. Jackson.*

P. HARVEYI, Bailey. Abundant in bays and on Bond's Bar, Egg Harbor, *Ashmead*; Staten Island, *Pike*; Atlantic City, *Morse, Martindale, Murphy*; Asbury Park, *Gardner*; Ocean Grove, *C. H. Kain*; Longport, *Lawton, McCullough, Murphy, Martindale, Porter*; Somer's Point, *McCormick.*

P. FIBRILLOSA (Dillw.), Grev. Longport, *Lawton, Martindale.*

P. VIOLACEA (Roth), Grev. Fine specimens collected at Prince's Bay, Staten Island, *Pike.*

P. VARIEGATA (Ag.), Zan. Common from Cape Cod to West Indies, *Farlow*; New York, *Hooper*; Egg Harbor, *Ashmead*; Staten Island, Asbury Park, Atlantic City, Longport, all collectors; unusually large and fine specimens, Somer's Point, *Porter.*

P. ATRORUBESCENS (Dillw.), Grev. Long Branch, *Miss Morris*; Asbury Park, *Gardner*; Atlantic City, *Martindale, Morse*; Communipaw and Staten Island, *J. Hooper, Pike.*

P. NIGRESCENS (Dillw.), Grev. Staten Island, Fort Hamilton

and New York, *Pike* ; abundant, Egg Harbor, *Ashmead* ; Ocean Grove, *Miss Boice, Gardner, Kain* ; Atlantic City, *Morse, Martindale, Murphy, Porter* ; Longport, *Lawton, McCullough* ; the latter secured some of the finest specimens yet found on the coast.

Var. FUCOIDES, Ag. Atlantic City, *Martindale* ; Longport, *McCullough.*

Var. AFFINIS, Ag. Atlantic City, *Martindale, Murphy* ; Longport, *McCullough.*

Var. DURKEEI, Harv. Atlantic City,, *Murphy, Martindale.*

Var. PLUMOSA, Harv. Longport, *McCullough*, very fine.

P. FASTIGIATA (Roth), Grev. Pleasure Bay, Communipaw and Staten Island, *Pike.*

BOSTRYCHIA, Mont.

B. RIVULARIS, Harv. Fort Lee, *H. Averill*, in Farlow Mar. Alg. New Eng ; on piling at the drawbridge, Atlantic City, *Morse, Martindale, Murphy* ; floating in the thoroughfare, *Porter* ; Longport, *Lawton, McCullough, Martindale.*

DASYA, Ag.

D. ELEGANS (Mart.), Ag. Common in New York Bay at Communipaw and Staten Island, *Britton, Pike* ; Atlantic City, *Morse, Martindale* ; floating in the thoroughfare, *Porter* ; Longport, *Lawton, McCullough, J. Hood, Murphy, Martindale.* The specimens collected by Miss Murphy in the summer of 1888 were very large and in very fine condition.

CORALLINEÆ.

CORALLINA (L.) Lamourx.

C. OFFICINALIS, L. Said to have been collected at Long Branch.

JANIA, Lamourx.

A specimen of this genus was collected at Longport in the summer of 1888 attached to *Sargassum*, washed up on the beach ; possibly *J. rubens*, Lamourx, or *J. Cubensis*, Mont., but not sufficiently developed to determine with certainty.

MELOBESIA, Lamourx.

M. LE JOLISII, Rosanoff. Atlantic City, *Murphy*, *Martindale*, *Morse*.

M. FARINOSA, Lamourx. On the New Jersey coast and along Staten Island, *Pike;* Atlantic City, *Morse*, *Martindale*, *Miss H. C. Bond*.

M. PUSTULATA, Lamourx. Same stations and same collectors; Somer's Point, *Porter;* Longport, *Martindale*.

M. LENORMANDI, Aresch. Staten Island, *Pike;* Long Branch, Longport and Atlantic City, *Martindale*.

M. MACROCARPA, Rosanoff. Staten Island, *Pike*.

GENERIC INDEX.

Ahnfeldtia, 104.
Alaria, 99.
Anabæna, 92.
Ascophyllum, 99.
Asperococcus, 98.
Bangia, 100.
Beggiatoa, 90.
Bostrychia, 108.
Brachytrichia, 91.
Bryopsis, 95.
Callithamnion, 100.
Calothrix, 91.
Castagnea, 98.
Ceramium, 102.
Chætomorpha, 93.
Champia, 105.
Chondriopsis, 106.
Chondrus, 104.
Chorda, 98.
Chordaria, 98.
Chroococcus, 89.
Cladophora, 94.
Cladostephus, 97.
Clathrocystis, 90.
Corallina, 108.
Cystoclonium, 104.
Dasya, 108.
Delesseria, 106.
Derbesia, 96.
Desmarestia, 96.
Dictyosiphon, 96.
Ectocarpus, 97.
Elachistea, 97.
Euthora, 104.
Entophysalis, 89.
Erythrotrichia, 100.
Fucus, 99.
Gelidium, 105.
Gigartina, 104.
Glœocapsa, 89.
Goniotrichium, 100.
Gracilaria, 106.
Griffithsia, 102.
Grinnellia, 105.
Gymnogongrus, 104.
Halurus, 102.
Hildenbrandtia, 100.
Hypnea, 105.
Isactis, 91.
Jania, 108.
Laminaria, 98.
Leathesia, 98.
Leptothrix, 90.
Lomentaria, 104.
Lyngbya, 90.
Melobesia, 109.
Mesogloia, 98.
Microcoleus, 90.
Monostroma, 92.
Myrionema, 97.
Myriotrichia, 96.
Nodularia, 92.
Oscillaria, 90.
Phyllitis, 96.
Phyllophora, 103.
Polycystis, 90.
Polyides, 105.
Polysiphonia, 107.
Porphyra, 100.
Ptilota, 102.
Punctaria, 96.
Ralfsia, 98.
Rhabdonia, 105.
Rhizoclonium, 94.
Rhodomela, 107.
Rhodymenia, 104.
Rivularia, 91.
Sargassum, 99.
Scytosiphon, 96.
Spermothamnion, 100.
Sphacelaria, 97.
Spirulina, 90.
Spyridia, 103.
Stilophora, 98.
Striaria, 98.
Trentepohlia, 100.
Ulva, 92.
Ulothrix, 93.
Vaucheria, 99.
Xenococcus, 89.

ISSUED AUG. 24, 1889.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. I. NO. 3.

HEPATICÆ BOLIVIANÆ,

IN ANDIBUS BOLIVIÆ ORIENTALIS, ANNIS 1885-6,
A CL. H. H. RUSBY LECTÆ.

BY RICHARD SPRUCE.

ISSUED JANUARY 20th, 1890.

LIBRARY OF
MISSOURI BOTANICAL
GARDEN.

PRICE, 75 CENTS.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

Vol. I. No. 3.

HEPATICÆ BOLIVIANÆ,

IN ANDIBUS BOLIVIÆ ORIENTALIS, ANNIS 1885–6, A CL. H. H. RUSBY LECTÆ.

BY RICHARD SPRUCE, Coneysthorpe, England.

The small collection of Hepaticæ made by Dr. Rusby on the eastern slope of the Bolivian Andes is an interesting addition to our scanty knowledge of the Cryptogamia of that region. It serves also for comparison with what we know of the hepatic flora of the Peruvian and Quitenian (equatorial) Andes, investigated by myself; of the Andes of New Granada, by Lindig and others; and of Mexico mainly by Liebmann. One curious fact brought out by that comparison is the greater correspondence of the hepatic flora of Bolivia with that of Mexico than with that of the equatorial regions (lat. 0°—7° S.) personally known to me. The climate and other conditions of growth in Mexico, a little within the northern tropic, may be more nearly conformable to those of Bolivia, in proximity to the southern tropic, than in the intervening portions of the Cordilleras. Anyhow, many of the hepatics of the highlands of Mexico are identical with those collected by Dr. Rusby at nearly the same altitude in Bolivia, and some of them were nowhere seen by myself near the equator. Of *Plagiochila*, for instance, at least three Mexican species which I did not gather in the Andes are proved to belong also in Bolivia; and two other Bolivian species which I suppose to be new have in Mexico their two nearest allies, neither of which is known to exist near the equator. *Lepicolea ochroleuca*, N. (*Sendtnera*, Syn. Hep.), a large and showy hepatic, grows rarely from Mexi-

co to the Falkland Isles, and now Bolivia is intercalated in its range; yet I never fell in with it. Fewer Bolivian species than might be predicated are identical with those of Chili or of South Brazil, but further researches may add to their number.

In the following catalogue the genera stand in nearly the same order as in my 'Hepaticæ Amazonicæ et Andinæ,' and I add a few prefatory remarks on some of the more notable genera and species.

A peculiar feature in the hepatic vegetation of Bolivia seems to be the paucity of species of *Frullania*, as contrasted with their great abundance and variety in the Equatorial Andes. They are such conspicuous plants, from their habit of forming large, shining, reddish-brown or lurid-purple patches on trees and rocks, that, if existent, they could not have been overlooked. Yet one species must have occurred in some quantity, as it forms the bulk of three of Dr. Rusby's packets; it is also new (*F. Boliviana*, n. sp.) and differs from its nearest ally, *F. tetraptera*, Mont., in the dioicous inflorescence and other important characters specified below. *F. tetraptera* was discovered by d'Orbigny in Chili, and a small fertile specimen has been picked out of Dr. Rusby's Sorata collections by Mrs. Britton. The remaining species are all in small quantity, but comprise some novelties, which will be described in their place.

The headquarters of the vast genus *Lejeunea* is in the hot, damp forests of equatorial plains. In the Quitenian Andes there is a considerable falling off in the number of species when we ascend above 4,000 feet, which is Dr. Rusby's lowest limit for hepatics in the Bolivian Andes. Three of his *Lejeunea* are in considerable quantity: *L.* (*Omphalanthus*) *filiformis* (Sw.); *L.* (*Taxilejeunea*) *isocalycina*, in broad, milk-white patches, rarely fertile; and a *Ceratolejeunea* which I have called *L. fastigiata*, n. sp., from the long, sub-simple stems growing in closely-packed bundles. Tropical ferns afford a prolific nidus for the minuter *Lejeuneæ*. On an *Acrostichum* gathered by Dr. Rusby grow, besides an undescribed *Radula*, some half dozen *Lejeuneæ*. One of these, *Ceratolejeunea malleigera*, n. sp., is the gem of the collection. It is abundantly fertile, and its most striking peculiarity is in the perianth being produced upward into two mallet-like

horns, that remind one of the antennæ of some tropical moths. *Lopholejeunea Rusbyi*, n. sp., is one of the larger species, and is fortunately in perfect state. Like its congeners it has the keels of the perianth bordered by a broad toothed wing, but in the acuminate serrated leaves it differs from all others. Most of the remaining *Lejeunea* are parasitic on other hepatics, and (with the exception of *L. denticulata*) are in small quantity—some indeed so scanty and imperfect that I do not venture to name them. Of those I recognize, the majority extend through tropical America to the Antilles and Mexico.

Radulæ are few and in small quantity, but include two new and very interesting species, and (what I was particularly pleased to see) good specimens, though sterile, of the true *R. Xalapensis*, Mont., which was so-named by Montagne from a site called Xalapa on the eastern side of Bolivia, and not from the famed Mexican city. *Radulæ*, like *Lejeuneæ*, are apt to grow much mixed up, and it was doubtless a specimen of *R. ramulina*, Tayl. which Gottsche received from Montagne under the name "*R. Xalapensis*" (having lurked undistinguished in the same tuft with the true plant) and described as such in "Mexikanske Levermosser." A stem or two of *R. ramulina* occurs attached to several of Dr. Rusby's *Plagiochilæ*: it is well distinguished from *R. Xalapensis* by its larger size, and especially by the abnormally large and overlapping lobule, in which it closely approaches the Irish *R. voluta*, Tayl.

Scapania Portoricensis, Gottsch. This, the only tropical American species of its genus known to me, and certainly one of the noblest, was gathered by myself in perfect fruit, growing on wax-palms in the forest of Canelos (June, 1857) and named in my MS. *Scapania splendida*, but not published until 1885. I did not even at the latter date know of the existence of a memoir on the Hepaticæ of Porto Rico, by M. M. Hampe and Gottsche, published so long ago as 1853, in which the same *Scapania* is described, but from barren specimens, and with the erroneous character of a quite entire lobule. Dr. Rusby gathered in Bolivia a single very fine plant of it, and I have picked fragments of the same off some of his other hepaticæ; but in these, as in others in Porto Rico and Jamaica (*Scap. grandis*, Bosw. in Journ.

Bot.) and in my own from Ecuador, the lobule is invariably finely toothed all round.

Isotachis serrulata, Sw., is one of the most conspicuous of hepaticæ from its size, its purple or blood-red color, and its habit of forming wide, dense patches, rarely with any admixture of other species. It is well represented in Dr. Rusby's collection, and we have it also from south Brazil and the Antilles, yet I was never fortunate enough to fall in with it.

The solitary species of *Herberta* (= *Sendtnera*, Syn.) differs from all others known to me by the serrated laciniæ of its deeply bifid leaves.

Bazzania is represented by four species, three of which have been previously found in Chili, New Granada, etc. *B. Rusbyi*, n. sp. is a very pretty species, notable for its pellucid foliage, its underleaves sharply spinuloso-dentate, etc. The Mexican *B. denticulata*, L. et G. is possibly its nearest congener, but is smaller, more opaque, and the underleaves are much less toothed, especially at the sides. In a genus where the numerous species are separated by such minute characters, two equally conscientious observers will often differ as to which are species and which varieties.

Of the five *Lepidoziæ* in the collection, two exist in some quantity, and were probably abundant. The one is *L. plumæformis*, nob. in Rév. Bryol. (1887) previously known to us only from scanty specimens gathered in south Brazil by Glaziou; the other is the widely-distributed *L. cupressina* (Sw.), which (as *L. tumidula*. Tayl.) extends as far north as the British Isles. A third *Lepidozia*, of which there are but few specimens, is a variety of *L. truncatella*, Nees, whereof the type is south African. Although the identity of an African with an American hepatic is to be admitted with caution, we have a few undoubted examples of such, e. g. *Lejeunea trifaria*, N. and *L. Sagraeana*, Mont.

Plagiochilæ constitute the bulk of Dr. Rusby's collection. They are in greatest variety in the sections Spinulosæ and Frondescentes, and they include a fair share of novelty. A *Plagiochila* near the common *P. asplenioides* of the north temperate zone, yet well distinguished, is the *P. alternans* of Gottsche, still known only in barren state. Although Dr. Rusby's specimens

extend its range from Mexico to Bolivia, and Mrs. Britton sends me the same, gathered by Mr. Hyde in Costa Rica, I never met with it in so much of the intervening space as I traversed.

In contrast with the abundance and variety of the Plagiochilæ Grandifoliæ in the Quitenian Andes is their paucity in Bolivia, only two species being clearly distinguishable. Yet one of these, *P. Notarisii*, notable for its large, flattish, semi-cordate, pauci-dentate leaves, seen by me in small quantity only in the valley of the Pastasa, has been gathered abundantly by Dr. Rusby.

Of the numerous species of the section Cristatæ I gathered in Amazonian and Andine forests Dr. Rusby's collection includes not one; but it has two other species, quite distinct from any of mine, whereof one had been previously discovered in Bolivia by d'Orbigny. The other (*P. Boliviana*, n. sp.), which I suppose to be new, comes very near the *P. punctualis*, G., found by Liebman in Mexico.

Lophocoleæ, with a single exception, are exceedingly rare. Of the sections Bidentatæ and Bicornutæ, so abundant in equatorial forests, fragments only of one, or possibly two species have been seen. But one other species, notable for its oblong-hexagonal leaves, with a ciliiform tooth at each of the four free angles (whence my name, *L. 4-dentata*, n. sp.) must have abounded, for it exists intermixed with nearly every other hepatic.

Of *Jungermania* there is only a single species, but it is new and very interesting. In the long sub-simple stems and the laterally accumbent roseate foliage, it might seem a slender form of *J. colorata*, from which it differs essentially in the *opposite* (not alternate) leaves, scarcely at all decurrent at the base. Unfortunately I found no perianths, though I sought for them sedulously.

The remaining genera are for the most part sparingly represented. There is one example of the anomalous genus *Noteroclada* (*N. arhiza*, n. sp.)—anomalous also as a species, from being almost utterly rootless, whereas its congeners have of all leafy hepaticæ the longest and strongest radicles.

There are luxuriant specimens, both ♂ and ♀, of *Marchantia chenopoda*, L.; and *Dumorticra hirsuta*, N., vindicates its claim to be a cosmopolite by appearing in very nearly the same form as the Irish variety (*D. irrigua*, Tayl.).

FRULLANIA, Raddi.

FRULLANIA (CHONANTHELIA) BOLIVIANA, n. sp.

Dioica, atropurpurea, flaccida, caulibus bipollicaribus, dense depresso-stratificatis, laxepinnatis bipinnatisque. Folia dissita, ramorum interdum subimbricata, late patentia, sub-concava, cordato-rotunda, auriculis baseos majusculis rotundis conniventibus; lobulus vix triplo brevior, cauli contiguus, late cuculliformis, margine orificii truncati interno paulo magis producto, sæpe compresso-inflexus, nunquam evolutus; cellulæ parvulæ, subconformes, ad angulos incrassatæ. Foliola duplo breviora, dissita, subrotunda, ex alis basi præcipue recurvis ad speciem spathulata, undulata, interdum medio margine in angulum obtusum producta, apice ad vel ultra $\frac{1}{3}$ acute obtuseve bifida, segmentis erectis acutis. Flores ♀ in ramis terminales. Bracteæ bijugæ, foliis subæquilongæ, profunde bifidæ, cum bracteola in cyathum alte connatæ; lobo antico ovato, rotundato; lobulo angustiore, acuminato, canaliculato, extus lacinula aucto; bracteola angusta, breviter bifida, segmentis subulatis, margine utrinque 1-dentata. Perianthia alte emersa, involucro duplo fere longiora, elongate ovato-oblonga, dimidio supero fere rectangulari-prismatica, altiuscule 4-carinata, ex apice rotundato longirostria. Andrœcia in planta propriâ tenuiore axillaria, globosa, folia æquantia; bracteis parvulis paucijugis.—Folia 1.3×1.05, lobulus .5, cellulæ $\frac{1}{40}$; foliola $.65 \times .55$; bracteæ 1.2×0.9; perianthia $2.2 \times .95^{mm}$.

Hab. Mapiri Boliviæ, alt. 5,000 ped; Unduavi, alt. 8,000 ped; Ingenio del Oro, alt. 10,000 ped. (Nos. 3,039, 3,040, 3,042). Ab hac distat *F. tetraptera*, Mont. (in Chili a d'Orbigny, in monte Sorata Boliviæ, alt. 10,000 ped. a Rusby lecta) florescentia monoica, statura minore, colore pallido viridive, foliis valde oblique cordatis, auricula antica magna truncata, postica vix ulla, apice cucullato-incurvis, lobulo interdum ex parte evoluto apiceque solum cucullato; foliolis brevissime (vix ad $\frac{1}{6}$) fissis; bracteis acutis vel acuminulatis, lobulo acuminato subserrato; perianthiis ubique æquilatis, præalte carinatis.

F. (CHONANTHELIA) TETRAPTERA, Mont. Ann. des Sc. Nat. 1838. In monte Sorata, alt. 10,000 ped. (3,087 p. p.)

F. (METEORIOPSIS) ATRATA (Sw.). Frustula pauca inter alias hepaticas.

F. (THYOPSIELLA) BRASILIENSIS, Raddi. Inter *Plagiochilas* cæspitans.

Frullania (Thyopsiella) humilis, n. sp.

Dioica, pusilla, rufo-badia, caule vix semipollicari laxe pinnatim ramoso. Folia imbricata, patentia, subplana, oblique ovalia obtusa vel rotundata, basi antica semi-cordata (auricula oblonga subtruncata); lobulus triplo brevior, a caule parum distans et divergens, vel eidem fere parallelus, obconico-campanulatus, lævis, interlobulo tenui, subulato; cellulæ parvæ, pachydermes, subpellucidæ, subrhombeo-4—6-gonæ, inferiores sensim submajores. Foliola foliis haud duplo breviora, subcontigua, oblonga, breviter (ad $\frac{1}{5}$) bifida, segmentis subacutis, margine laterali recurvo, basi breviter auriculata. Flores ♀ in ramo terminales. Bracteæ intimæ foliis duplo longiores, lobo ovato apiculato integerrimo subplano, lobulo æquilongo angustiore deltoideo-lanceolato subacuto, infra medium utrinque rude unidentato; bracteola paulo brevior, libera, oblonga ad $\frac{1}{2}$ fere bifida, segmentis late subulatis acutis recurvo-canaliculatis, basi processulo tenui aucta. Perianthium (valde juvenile) lageniforme, apice in tubum sat longum et latum abiens, omnino ecarinatum. Pistillidia quatuor, prælonga. Folia .55×.35, lobulus .18, cellulæ $\frac{1}{50}$; foliola .32×.20; bracteæ 1.0×.65, bracteola .85×.5^{mm}.

Hab. Prope Yungas, Boliviæ, in Orchidearum radicibus (No. 3,061). A *F. Brasiliana* certe diversa, statura humiliore, foliis obtusissimis, etc.

Frullania (Thyopsiella) mollicula, Spruce. (*F. rigescens* var. *mollicula*, Hep. Am. et And.)

Dioica, rufescens, dense stratificata; caules bipollicares symmetrice sed laxiuscule bipinnati, frondem anguste oblongam sistentes, ramis sæpe arcuantibus. Folia concinne non autem arcte imbricata, late patentia, concava, oblique semicordato-ovata, ex rotundato apice præminute apiculata, rarius mutica, toto margine incurvulo, auricula antica oblongo-rotunda; lobulus 6-plo fere brevior, erectus, anguste conicus, obtusus; cellulæ parvæ, opacæ, omnes fere—ad mediam basin præcipue—oblongatæ, trigonis magnis pellucidis. Foliola imbricata, foliis æquilata, dimidio breviora, orbiculata, ad $\frac{1}{3}$ bifida, segmentis sub-acutis, margine anguste recurva, basi utrinque auricula magna rotunda aucta. Flores ♀ in ramis terminales. Bracteæ foliis sat majores, cochleato-concavæ, appressæ, ovato-orbiculatæ, ad $\frac{1}{2}$ bifidæ, lobis sub æqualibus breviter tenui-acuminatis, postico autem inæqualiter bilobo et paucilaciniato; bracteola late ovalis, segmentis longius acuminatis sublaciniatis. Perianthia subsemiemersa, subcylindrica, alia superne paulo latiora, valde obtusetrigona—in ætate fere teretia—ex apice corrugato-inflexo, demum lacero, tenuirostel-

lata.—Folia 1.4×.9, lobulus .25, cellulæ $\frac{1}{30}$; foliola 1.0×.9; bracteæ 2.0; perianthia3.0×1.0^{mm}.

Hab. Ad Yungas, Boliviæ, alt. 6,000 ped. (no. 3,062 p.p.)—A *F. rigescente* et *F. laticauli* recedit habitu graciliore, ramificatione concinna; foliis subovatis; foliolis grandiauriculatis, paulo longioribus quam latis; bracteis latioribus, longius acuminatis, lobis pauciliniatis vel fere integerrimis;p erianthiis apice pro m. inflexis. (Stirps Peruviana parum differt bracteis semper subintegerrimis et perianthiis apice conicis raro inflexis.)

FRULLANIA (THYOPSIELLA) LATICAULIS, n. sp.

Dioica, rufo-badia, caule 2-pollicari inæqualiter pinnato et subbipinnato, ramisque late foliatis. Folia arcte imbricata, patenti-divergentia, semicordato-oblonga abrupte subacuta, raro subapiculata, toto margine incurvulo, auricula antica subtruncato-rotundata; lobulus parvus (folio 5-plo brevior) tectus, breviclavatus vel obovatoc ylindricus,cauli approximatus et subparallelus, lævis, interlobulo minuto triangulari; cellulæ parvæ pachydermes subæquilateræ. Foliola imbricata, late orbiculata, foliis æquilata sed breviora, basi breviter biauriculata, apice ad ⅓ acute bifida, segmentis ovatis minute apiculatis, apiculo (e margine toto anguste recurvo) abscondito. Flores ♀ terminales. Bracteæ intimæ foliis majores ultra ½ bilobæ, lobis oblique ovato-oblongis cuspidatis, postice pauci-rude-dentatis, lobulis subæquilongis inæqualite rbifidis et segmentis bracteolæ oblongæ ad ½ fissæ lanceolatis acuminatis breviuscule laciniatis.—Folia 1.4×1.0, lobulus .3, cellula $\frac{1}{32}$; foliola .9×1.0; bracteæ (lobus) 1.8×1.0, bracteola 1.6×9^{mm}.

Hab. Ad Yungas Boliviæ, alt. 6,000 ped. no. 3,062 p.p.—Ab hac differt *F. rigescens* Hep. Amaz., foliis brevioribus et rotundioribus, auriculâ anticâ majore crispatâ, margine postico toto fere latius incurvo (ad *Lej. xanthocarpæ* instar), lobulo præminuto; foliolis basi angustatis; bractearum lobulis bracteolisque longissime laciniatis; perianthiis apice subulatis.

OBS.—*F. laticaulis*, although included in the same packet as *F. mollicula*, had evidently grown apart from it, and, when moistened, the much broader stem (with the leaves), the irregular branching, and the other characters, seemed sufficient to separate it specifically.

FRULLANIA (DIASTALOBA) ODONTOSTIPA, n. sp.

Dioica, pusilla, rufo-badia, laxe reptans, caule sesquipollicari, pinnato, ramis breviusculis sæpe parvifoliis. Folia dissita vel

contigua—ramea subimbricata—subdivergentia, late oblique ovata, subplana, apice decurvulo abrupte acuta vel brevissime apiculata, basi antica subsemicordata caulem velantia; lobulus 4-plo brevior, obovatus clavatusve, celluloso-papulosus, a caule distans, parum divergens, interlobulo magno subrhombeo; cellulæ parvulæ rhomboideo-hexagonæ, trigonis magnis, paucæ basales submajores. Foliola foliis vix duplo breviora, subquadrata, ad $\frac{1}{3}$ bifida, segmentis subacuminatis, utrinque rude 1-3 dentatis lacinulatisve.—Folia .65×.55, lobulus .15, cellulæ $\frac{1}{70}$; foliola .35×.30mm.

Hab. Supra *Lejeuneam filiformem*, Sw. reptans, pauca exemplaria sterilia carpsi. (No. 3,069, etc.)—A *Frullania Magellanica* ceterisque Diastalobis certe distincta.

LEJEUNEA, Lib.

L. (OMPHALANTHUS) FILIFORMIS (Sw.) Ubique Andium sylvestrium, in ditione Yungas præcipue, frequens, nunc cespites latos homogeneos sistens, nunc *Plagiochilis* ceterisque hepaticis immixta (Nos. 3,069, 3,043, 3,017, 3,083 p.p.)

L. (BRYOPTERIS) TENUICAULIS, Tayl. Ingenio del Oro, 10,000 ped., pl. ♂ sola. (No. 3,030).

L. (BRACHIOLEJEUNEA) LAXIFOLIA, Tayl. Sorata, 10,000 ped. No. 3,087; Unduavi, 12,000 ped. (No. 3,089 p.p).

L. (BRACHIOLEJEUNEA) BICOLOR, Mont. Frustula sola, cum *Plagiochilis* mixta.—First described by Montagne from Bolivian specimens, gathered by d'Orbigny.

LEJEUNEA (BRACHIOLEJEUNEA) CLAVULATA, n. sp.

Dioica, pallide rufo-viridis, caule e caudice repente libero subarhizo, pollicari, vage ramoso. Folia dense imbricata, superiora sensim majora, decurva, in sicco devoluta (unde rami clavato-julacei videntur), oblique semicordato-ovata, rotundata vel abrupte obtusa, recte vel subsinuato-complicata; lobulus triplo fere brevior, ad carinam convexam inflatus, margine appresso transverso tridenticulato; cellulæ mediocres, subpellucidæ, pariete ad angulos, interdum etiam ad latera incrassato. Foliola perpaulo minora imbricata, late orbiculata, longissime decurrentia, toto ambitu, (apice excepto) recurva, cochleata. Flores ♂ in rami apice mediove spicati; bracteæ plurijugæ, foliis minores, inflatæ, lobo ovato, lobulo breviore apice libero plerumque triangulari; antheridia bina, magna, stipitata.—Folia 1.3×0.9, lobulus alt. .5, cellulæ $\frac{1}{38}$; foliola .65 longa (ad axin) 1.0 (ab ipsa basi decurrente), 1.0mm lata.

Hab. Mapiri, Bolivia, (No. 3,072). *L. corticali*, L., et L. subaffinis, differt, ramis clavatis, foliis multo majoribus, foliolis pro ratione maximis, apice rotundatis (nec cuneatis ac retuso-truncatis).

L. (HOMALOLEJEUNEA) GUILLEMINIANA, Nees. Exemplaria perpauca (fertilia) inter *Plagiochilas* vigentia.

L. (DICRANOLEJEUNEA) AXILLARIS, Mont. Inter cæspites *Taxilej. isocalycinæ*, e. a. serpens.

LEJEUNEA (LOPHOLEJEUNEA) RUSBYI, n. sp.

Monoica et dioica, olivaceo-viridis, elatiuscula, caule repente, 1—1 ½ poll. longo, vage ramoso, ramis inæquilongis. Folia subdivergentia, subimbricata, oblique semicordato-ovata, breviuscule acuminata, acuta, apice decurvo serrulata, raro integerrima, subsinuato-complicata, lobulo plus duplo breviore, inflato, ovoideo-conico, apice truncato, apiculo incurvo aucto; cellulæ mediocres, conformes ambitu opacæ, trigonis parvis ad angulos et media latera incrassatæ. Foliola lobulis sub-breviora, distantia, orbiculata, apice leviter recurva. Flores ♀ in caule ramove terminales, absque innovatione. Bracteæ foliis longiores, falcato-dimidiatæ, acuminatæ, toto fere margine distanter serrulatæ, lobulo duplo breviore lineari subcomplicato auctæ; bracteola (= bracteæ ⅔) oblongo-rotunda, integerrima. Perianthia alte emersa, obovata, brevirostria, inferne sensim angustata, compressula, alte 4-carinata (facie antica subecarinata), carinis ab ipsa ferebasi alâ crebre laciniatâ armatis, laciniis subulatis curvulis. Andrœcia ramo inferiore constantia; bracteæ plurijugæ, lobis parum inflatis, subæqualibus, obtusatis.—Folia .85×.65, lobulus .38, cellulæ $\frac{1}{32}$; foliola .35×.4; bractea 1.05×.65, bracteola .65×.6; perianthia 1.3 ×.9^{mm}.

Hab. Inter *Plagiochilas* ad Mapiri Boliviæ orientalis; alt. 5,000 ped. (No. 3,081). A *L. Muelleriana*, G. proxima, differt foliis acuminatis subserratis, foliolis longe minoribus, etc.

L. (ANOPLOLEJEUNEA) HERPESTICA, Hep. Am. et And.—In *L. filiformi* aliisque hepaticis sparsim hospitans.

This very curious hepatic was found only once by myself, in very small quantity, but fertile, on the upper Rio Negro. In Bolivia, however, it was gathered by Dr. Rusby at all his stations, growing sparingly, intermixed with other hepatics, and always sterile.

L. (ODONTOLEJEUNEA) PERUVIANA, L. et L. In *Acrostichi* frondibus ad Yungas (No. 3,025 p.p.)

L. (Prionolejeunea) leptocardia, Spruce, Hep. A. et A. In *Acrosticho*, cum priore, pulchre fructifera.

L. (Prionolejeunea) denticulata, Web. In *Plagiochilis* frequenter reptans. Sterile plants of one or two apparently distinct species also occur, but very sparingly.

L. (Prionolejeunea) microdonta, G. In *Plagiochila*, parcissime.

Lejeunea (Ceratolejeunea) malleigera, n. sp.

Monoica, pusilla, rufo-badia, subbipinnata, caule semipollicari prostrato. Folia sat magna, subimbricata, late patentia, vix decurvula, late dimidiato-ovata, subfalcata, integerrima, abrupte acuta, rarius subobtusa, recte vel subsinuato-complicata, lobulo 5-plo breviore, ovato-rhomboideo, subinflato, truncato; cellulæ parvulæ, leptodermes, subconformes, basin et marginem posticum versus sensim submajores. Foliola triplo breviora, distantia, ovalia, ad ½ bifida, segmentis acutis vel subobtusis. Flores ♀ in ramo pro m. brevi, innovatione suffulti. Bracteæ appressæ, foliis breviores, complicato-bilobæ, lobis semiobovato-lanceolatis obtusatis; bracteola cuneato-lanceolata, ad ½ bifida, segmentis acutis. Perianthia nisi pro cornibus immersa, obovato-obconica, sat compressa, tetragona, angulis duobus posticis in cornua clavata (formâ potius bicipitis mallei) erecta protracta, clavis apicalibus sat magnis subcylindricis, pallidis, reticulatis, ad speciem stipitatis. Andrœcia spicata; bracteæ subdissitæ, oblongo-cymbiformes, fere æquilobæ.—Folia .75×.5, lobulus .15, cellulæ $\frac{1}{70}$; foliola .25×.15; bracteæ .5, bracteola .4; perianthia .4×.2 (sine malleis .3; capite .2, stipite .1^{mm}.)

Hab. In fronde *Acrostichi*, in Andibus Boliviæ orientalibus (No. 3,025 p.p.).

Lejeunea (Ceratolejeunea) fastigiata, n. sp.

Dioica, elata, olivaceo-badia, caulibus 2-3 pollicaribus, arcte cæspitosis, fastigiatis, subsimplicibus, rarius ramulis parvifoliis pinnulatis. Folia magna, subimbricata, valde decurvo-concava, semicordato-oblonga vel ovato-oblonga, basi anticâ caulem late transeuntia, posticâ subrecte lobulata, lobulo minuto ovoideo apice inflexo, in ramis interdum majore et saccato, raro in utriculum magnum dilatato, apice plerumque subabrupte breviapiculata rarius 2-4 denticulata; cellulæ mediocres, subpellucidæ, conformes, basin versus paulo majores ocellum vix sistentes. Foliola foliis subæquimagna, late orbiculata, basi profundissime cordata, apice rima triangulari ad ¼ fissa, segmentis subacumi-

natis acutis, margine utrinque late incurva. Flores nullos invenire potui.—Folia 1.3×1.0, 1.05×.75; lobulus .15, cellulæ $\frac{1}{28}$; foliola .95×1.05, .8×1.05^{mm}.

Hab. In Andibus Boliviæ orientalibus sylvaticis, ut videtur ad rupes humidas, sociis *L. filiformi*, *Leioscypho schizostomate*, *Jungermania oppositifolia* n. sp., late cæspitosa, vel in *Plagiochilis* repens, (No. 3,035A, &c). Ab affinibus distat foliis pro m. breviapiculatis; foliolis maximis, basi altissime emarginato-cordatis, segmentis apicis subacuminatis. Frequens videretur, semper autem sterilis et eflorifera.

L. (CERATOLEJEUNEA) ARHEXIA, Spruce Ms.—A single stem growing with *L. pallescens*. Among my Andine plants I have found fertile specimens of this new species, which is one of the very few Ceratolejeuneæ having underleaves entire at the apex.

LEJEUNEA (HARPALEJEUNEA) INCRESCENS, n. sp.

Monoica, minuta, caule 3^{mm} longo, repente, parce et vage ramoso. Folia subcontigua, subplana, divergentia, oblique ovalia breviuscule acuminata, acuta, sinuato-complicata; lobulus triplo brevior, semiovoideus, turgidus, apice inflexo; cellulæ parvæ subæquilateræ, planæ, pellucidæ, ambitu anguste opacæ. Foliola minuta, lobulis subduplo breviora, squarrosa, obovata, ad ½ bifida, segmentis acutis. Flores ♀ in ramo brevi (innovato) terminales. Bracteæ foliis sublongiores, lanceolatæ, parvi-lobulatæ; bracteola angusta, ad ¼ bifida. Perianthia parum emersa, late pyriformia, subturbinata, 5 carinata, carinis papillis articulatis armatis. Andrœcia rara, parva, bracteis 1-2 jugis.—Folia .3×.2; perianthia .45×.35^{mm}.

Hab. In *Lej.* (*Bryopteride*) *tenuicauli*, T., parasitans, juxta Ingenio del Oro, Boliviæ.—A nostra *L. trachygona*, Hep. A. A. diversa, cui adsunt caulis pinnatus, folia ovato-acuminata, fornicata, celluloso-crenulata, perianthia multo longiora, etc.

Flowerless stems of two other *Harpalejeuneæ* were picked off other hepaticæ, but too imperfect to be named with certainty.

L. (DREPANOLEJEUNEA) STENOPHYLLA, Ldng.?—Mapiri, 5,000 ped (No. 3.075 p. p.)—I have not seen original specimens of Lindenberg's plant, but fertile specimens picked out of Liebmann's hepatics agree with the description in "Hep. Mexicanæ," and they are quite the same as the Bolivian plant, which, however, is sterile.

L. (Drepanolejeunea) inchoata, Meissn. Frustula sola visa in *Plagiochila* parasitantia.

L (Taxilejeunea) isocalycina, G. Yungas, etc., ut videtur haud infrequens, colore albicante insignis, raro tamen fertilis. (Nos. 3,035, 3,028 p. p.).

Lejeunea (Taxilejeunea) marasmodes, n. sp.

Dioica (?) virens, flaccidissima, caule pollicari parum ramoso. Folia distantia, subplana, semiovato-triangularia, apiculata acuminulatave, elobulata, basi antica rotundata vix semicordata; cellulæ mediocres, subconformes, pellucidæ. Foliola plus duplo breviora, distantia, late subcordato-ovata, ad $\frac{1}{3}$ obtuse fissa, segmentis acutis. Flores ♀ in ramo brevi seriati (manci solum visi). Folia 1.0×1.0, cellulæ $\frac{1}{32}$; foliola .4×.4^{mm}.

Hab. Supra *Noterocladam arhizam* et *Marchantiam* sp. repens, ad Sorata, alt. 10,000 ped., in Andibus Bolivianis sub. No. 3,005 p.p.

L. (Macrolejeunea) subsimplex, Mont. Pauca exempl. in *Plagiochila* decerpta.

L. (Macrolejeunea) pallescens, Mitt. var. Yungas, 6,000 ped. (No. 3,050 p.p.). A typo æquatoriali differt foliis planioribus brevius acuminatis; foliolis basi vix cordatis, segmentis solum acutis. Perianthia autem eadem sunt: minuta, primum superne obtuse 5-gona, matura teretia, solum apice obscure 5-corrugato inflexo. Florescentia etiam monoica exacte conformis est.

L. (Hygrolejeunea) cerina. Yungas, 6,000 ped. (No. 3,028 p.p.)

L. (Hygrolejeunea) reflexistipula. Frustula supra *Plagiochilam* inventa.

Lejeunea (Hygrolejeunea) Pastasensis, Spruce, in Hep. Am. et And. var. punctulata n. var.

Dioica, caule pollicari, repente, subpinnato. Folia magna flavescentia, subimbricata, late patentia, oblique semicordato-ovata, apice decurvo acuta, subsinuato-complicata, lobulo vix triplo breviore semiovato, solum ad plicaturam subrectam subinflato, margine rotundato appresso, in lobum sensim transeunte vel breviter truncato; cellulæ mediocres, leptodermes, pellucidæ, aliæ autem ubique in folio sparsæ, cæteris cellulis æquimagnæ vel minores, annulo opaco circumdatæ, solum in centro pellu-

cidæ. Foliola paulo minora, subimbricata, cordato-reniformia, apice lato recurvulo brevissime bidentula, dentibus acutis, sinu obtuso.—Folia 1.5×1.25, lobulus $.6 \times .4$; cellulæ $\frac{1}{30}$; foliola $.85 \times 1.1^{mm}$.

Hab. Bolivia, juxta Mapirí, in arboris ramulo, (No. 3,075).—*L. devoluta*, Hep. Am. et And. folia foliolaque habet minora, crenulata, hæc magis transversa toto margine recurva, cellulas minores, omnes conformes; *L. Pastasensis* ejusd. op. tamen a stirpe Boliviana vix differt nisi foliis subapiculatis epunctatis.

LEJEUNEA (EULEJEUNEA) GRACILICAULIS, n. sp.

Dioica, pusilla, virescens, caule semipollicari, repente, tenui, flaccido, elongato, sæpe ramulis parvifoliis pinnulato. Folia subdissita vel parum imbricata, late patentia, plana, suboblique oblongo-orbiculata, subsinuato-complicata, lobulo 4-plo fere breviore, ovoideo, inflato, apice brevi inflexo; cellulæ parvulæ, pellucidæ, leptodermes. Foliola foliis triplo breviora, obovato-cuneata, ultra ½ bifida, segmentis lineari lanceolatis, 4 cellulas latis, obtusis vel subacutis.—Folia $.45 \times .35$, lobulus $.125$, cellulæ $\frac{1}{40}$; foliola $.15^{mm}$.

Hab. Bolivia, loco Mapirí, *Plagiochilæ* sp. irrepens (No. 3,078 p.p.).—Ab omnibus Eulejeuneis parvistipulis diversa.

L. (EULEJUNEA) GAUDICHAUDII Ldng. var. In *Plagiochilis* parasitans (No. 3,049, 3,075, &c., p.p.). Cum exempl. cl. Gaudichaudi archetypis comparata foliis laxioribus planioribusque et vix aliter differt.

L (EUOSMOLEJEUNEA) CONDENSATA Spruce, Hep. Am. et And. Yungas, &c., cum *Lepidoziis* præcipue consociata (No. 3,070, 3,071, 3,075, p.p.).

RADULA, Dumort.

R. RAMULINA, Tayl. (*R. Xalapensis* G. Mex. Leverm. nec Montagnei).—Yungas, cum *Plagiochila frausa* (No. 3085 p. p.); etiam *Plagiochilas* varias varo infestans.

R. XALAPENSIS Mont.! Ann. des Sc. Nat. (1836); ejusdem in d'Orbigny Voy. dans l'Amérique, 62, t. 2, fig. 4.

Through the favor of M. Bescherelle I have been able to examine Montagne's original specimens of this species, and can testify to the accuracy of his description and figure above cited. The "*R. Xalapensis*" described by Gottsche in 'Mex. Levêrm.'

is an entirely different plant, viz. the *R. ramulina*, Tayl., which stands next to the Irish *R. voluta*, Tayl. Dr. Rusby gathered the true *R. Xalapensis* at Yungas (alt. 6,000 ft.), No. 3,034, and *R. ramulina* occurs sparingly in several packets of his collection, mixed mainly with *Plagiochilæ*; but his *R. Xalapensis* is accompanied by a new and very distinct species of the same genus (*R. clavulata*, Ms.) which has the rare peculiarity of a monoicous (autoicous) inflorescence, the great mass of the genus consisting of purely dioicous species.

R. PALLENS, Sw. *var.* Yungas, etc., (cum Nos. 3,063, 3,009, 3086, mixta).

R. AMAZONICA, Spruce Hep. A. et A. Inter Plagiochilas rarius reptans. (No. 3,055, etc.)—Specimina speciei affinis, nimis juvenilia et incompleta, adsunt sub No. 3,052.

RADULA MAMMOSA, n. sp.

Dioica, pusilla, flavens, arcte repens, caule 1-1½-pollicari, laxe bipinnato, ramis subinde dichotomis. Folia subimbricata, supra lobulum divergentia, falcato-oblonga, rotundata, valide sinuato-complicata; lobulus plus duplo brevior, subrhombeus, valde saccatus et ex eo deorsum arcuatus vel fere in angulum abiens, mammillam præaltam obtúse conicam proferens, ad originem superiorem haud auriculatus; cellulæ parvulæ, opacæ, trigonis nullis. (Folia caulina inferiora interdum vix mammillifera). Flores ♀ terminales cum innovatione, sæpe dichotomiales. Bracteæ foliis minores, magis falcatæ, lobulo angusto plano. Perianthia alte exserta, foliis 4-5 plo longiora, stricta vel arcuantia, clavato-tubæformia, inferne teretia, ore compresso, truncato, obscure laticrenato.—Folia .8×.55 (ad lobuli apicem)×.8 (ad basin ipsum) lobulus .3 (ad insertionem mensus), cellulæ $\frac{1}{60}$; perianthia 3.0-4.0 ×.55^{mm}.

Hab. Bolivia orientali in *Acrostichi* frondibus cum *Lejeuneis* repens. (No. 3,025 p.p).

RADULA CLAVÆFLORA, n. sp.

Autoica, flavicans, 1-1½ pollices longa, caule nisi in ipsa basi a matrice libero subpinnatim ramosa. Folia subplana, subimbricata, late patentia, basi in caule utrinque alte incurrentia, semicordato-oblonga, rotundata auricula basali caulem transeunte, subrecte complicata; lobulus triplo fere brevior, subquadratus, ad carinam vix inflatam recte vel arcuatim decurrens, obtusus, margine supero carinæ subparallelo medio sinuato-inflexo, angulo

basali libero parvo caulem vix velante, mammilla vix ulla, raro radicellifera; cellulæ parvæ, subæquales, ambitu late opacæ, pariete pellucido ad angulos perpaulo incrassato. Flores ♀ terminales, innovati, sæpe dichotomiales. Bracteæ foliis subbreviores erectæ, complicatæ, lobo subfalcato-oblongo, lobulo fere æquilato duplo (vel solum dimidio) breviore. Perianthia foliis plus duplo longiora, clavata, inferne teretia, ore compresso truncato subcrenulata. Andrœcia in caule ramisque media, rarius terminalia; bracteæ paucijugæ, foliis breviores, turgidæ, lobulo lobi $\frac{2}{3}$ æquante.—Folia 1.3×0.9, lobulus (ad carinam) .5, cellulæ $\frac{1}{18}$; bracteæ lobus 1.1×.55; perianthium 3.0×.3 (basi)×.7 (apice) mm.

Hab. Ad arborum ramos in prov. Yungas, Bolivæ, alt. 6,000 ped., socia *R. Xalapensi* Mont.—*R. Cordovana* Steph. in 'Hedwigia' (1884), huic quoad florescentiam proxima, differt foliis ovatis, haud decurrentibus, et perianthio a basi obconica oblongo.

SCAPANIA, Dumort.

S. Portoricensis, Hampe et G., Hep. Portoricenses (1853); *S. splendida*, Spruce, Hep. A. et A. (1885). Yungas, alt. 6,000 ped. (No. 3,068 p.p.)

ISOTACHIS, Mitt.

I. serrulata (Sw). Yungas, alt. 6,000 ped. (No. 3,037). Unduavi, alt. 10,000 ped. (No. 3,038.) Specimina pulcherrima!

HERBERTA, Gray.

Herberta serrata, n. sp.

Dioica, rufo-fusca, caule bipollicari, a basi tenui subrhizomatosâ parce flagelliferâ assurgens, simplex vel subramosa. Folia magna, densa, inferne breviter erecta dein subsquarroso-secunda, foliolaque (vix minora, magis exacte transversa) dimidio inferiore ovalia concava, margine runcinato-dentata, basi subsagittatim producta, ad medium bifida; laciniis lineari-subulatis, acutis, canaliculatis, inæqualiter serratis; cellulæ subconcolores, axiales (pluriseriatæ) majusculæ, lineares, plerumque medium versus utrinque isthmo tenui cum collateralibus anastomosantes, marginales breviores subrhomboideæ, omnes valde pachydermes, pariete latissimo. Flores ♀ in caule terminales, innovati. Bracteæ plurijugæ foliis submajores, dense imbricatæ, profunde bisulcæ, infra medium arcte runcinato-dentatæ; laciniæ laciniato-serratæ.—Foliorum pars integra 2.0×1.35, laciniæ 2.0×0.5, cellulæ mediæ $\frac{1}{20}$, submarginales $\frac{1}{28}$ mm.

Hab. In Boliviæ Andibus, loco Unduavi, alt. 10,000 ped., muscis immixta, (No. 3,084).—Differt *H. runcinata*, Tayl. foliis basi cordatis, laciniis integerrimis, etc.

LEPICOLEA, Dumort.

L. OCHROLEUCA, Nees. Yungas, alt. 6,000 ped. (No. 3,068 p. p.)

BAZZANIA, Gray.

B. ARCUATA, L. et G. Mapiri, alt. 5,000 ped. (No. 3,027).

B. CHILENSIS, Steph. Yungas, alt. 6,000 ped. (No. 3,029 p. p).

B. LINDIGII, Gottsch. Yungas, alt. 6,000 ped. (No. 3,023).

BAZZANIA RUSBYI, n. sp.

Dioica, depresso-cæspitosa, 5^{cm} longa, pallide viridis, pellucida, iteratim dichotoma, angulo furcavum recto, flagellifera. Folia majuscula, alterna, subimbricata, patenti-decurvula, oblique semicordato-ovato-ligulata, oblique truncato-tridentata, dentibus subacuminatis acutis, medio plerumque submajore, sinubus acutis rarius obtusis, basi anticâ caulem transeuntia, posticâ inflexa; cellulæ pellucidæ, subconformes, axiales et subbasales submajores et oblongatæ, ad auriculam multo minores, omnes pachydermes trigonis (haud magnis) solum ad angulos, mediis nullis. Foliola triplo fere breviora, contigua vel subdissita, rotundo-quadrata, toto margine argute spinuloso-dentata, spinulis ad apicem latum truncatum 5-8, ad marginem utrinque sub 4, basi hinc minute auriculata, illinc cum folio collaterali subconnata; cellulæ omnes conformes, basin versus sensim paulo minores.—Folia 2.35×1.35, cellulæ mediæ $\frac{1}{78}$; foliola .85×.85mm.

Hab. In Bolivia orientali, alt. 6,000 ped., loco Yungas, ad truncos velustos. (No. 3,029).—Species insignis, quoad foliola ubique argute dentata, solum cum *B. Peruviana* et *B. Novæ-Hollandiæ* comparanda, quibus autem adsunt folia semper opposita. *B. Lechleri*, Steph. subsimilis, minor est, fuscescens, sinubus foliorum apicalibus lunatis; foliolis margine solum angulatis, cellulis apicalibus elongatis. *B. denticulata*, L. et. G., forsan magis affinis, distat statura humiliore, opacitate (quando *B. Rusbyi* insigniter pellucida est), foliolis multo minus argute dentatis, margine præcipue, etc.

LEPIDOZIA, Dumort.

L. CUPRESSINA (Sw). Yungas; Mapiri, cum Orchideis, etc. (Nos. 3,026, 3,064, 3,070, 3,071). Agrees well with an original Jamaican specimen from Swartz. Grows in wide depressed tufts, very much as *L. reptans* does with us. Leaves have sometimes, but very rarely, 1-3 rudimentary teeth at antical base. Near insertion of a branch a six-cleft underleaf is occasionally seen. Laciniæ of both side leaves and under leaves are simply subulate, rarely with the slightest acumination. But in the Peruvian *L. tenuicuspis* (= *L. cupressina* var. *tenuicuspis*, Hep. A. et A.) all the leaf segments end in a slender cusp of a single row of cells—in the underleaves as much as 6-9 cells long. From this and some other differences I prefer to regard it as a distinct species, under the MS. name (*L. tenuicuspis*) proposed in 'Hep. Am. et And.'; especially as I have seen no intermediate form from any country.

LEPIDOZIA TRUNCATELLA, N. VAR. ALTIRIMATA, S.

Dioica, griseo-viridis, laxe depresso-cæspitosa; caules sesquipollicares laxe pinnati, pinnis longitudine variis, aliis prelongis, persæpe apice flagellari-attenuatis, rarius pinnulatis. Folia imbricata, subtransversa, concava, suboblique ovato-quadrata, profunde 4-fida (antice paulo ultra medium, postice ad ¾ usque), basi utrinque subampliata, antice rude 2–3–dentata, postice hastatim 1-dentata; laciniæ subulatæ repandæ, postica paulo minore, sinubus acutis, cellulæ parvæ, subquadratæ, pachydermes, trigonis vix ullis. Foliola perpaulo breviora, quadrata, basi utrinque 1--3 dentata, ab apice ultra ¾ quadrifida, laciniis lineari-subulatis, obtusis vel subacutis, repandis, quinta minore interdum adjecta.—Folia .5×.5; foliola .4×.35; cellulæ $\frac{1}{55}$mm.

Hab. ad viam quæ ducit à Sorata ad Mapirí, in arboribus vetustis saxisque (No. 3,082)—A. *L. truncatella*, L. et G., Capensi, distat foliis, foliolisque magis profunde fissis vix autem specifice separanda.

L. PLUMÆFORMIS, Spruce, n. sp. in Hep. Glaziovianis No. 7,135 Rév. Bryol. 1887.—Yungas, alt. 4,000 ped. (No. 3,046).

L. CAPILLARIS, Sw.—Cum *Plagiochilis* et *Bazzaniis* rarius immixta, semper sterilis.

L. (TELARANEA) sp.—Cum priore aliisque, rarissime. Forsan pro *L. chætophyllæ*, Hep A. et A. var. habenda.

CEPHALOZIA, Dumort.

1. Cephalozia fragillima, n .sp.

Dioica, pusilla, albicans, caule semipollicari, tenui, fragillimo, paucirameo, æquifoliato. Folia dissita, subdivergentia, cuneata, ultra ½ bifida, segmentis late subulatis, acuminatis; cellulæ minutulæ, pellucidæ, oblongo-quadratæ. Foliola nulla. Flores ♀ rari, in ramo pro m. brevi postico terminales; imperfecti solum visi, muco obtecti. Bracteæ serratæ. Perianthia trigona (imperfecta muco obruta).

Hab. Bolivia, loco Mapiri (No. 3,076)—Incomplete descripta attamen a *C. divaricata* certe distincta.—In eodem cespite, arcte intricata crescit *Marsupellæ* species, sterilis, olivacea, foliis duplo majoribus, subcomplicatis, ad medium solum bifidis, segmentis semi-lanceolatis, acutis vel subobtusis. Indescripta videretur.

PLAGIOCHILA, Dumort.

Plagiochila (§ Spinulosæ) Mapiriensis, n. sp.

Dioica, rufescens; caules sesquipollicares, e caudice breviter repente suberecti flexuosi, parum ramosi. Folia approximata, opposita, decurvo-secunda, dimidiato-oblonga vel subovato-oblonga, obtusa vel truncata, utrinque decurrentia, margine antico recurvo integerrima vel sub apice 1–2-dentata, postico supra basin cuneatam integram apiceque paucispinoso-dentata, dentibus omnibus 8–15, inæqualibus, duobus apicalibus sæpe magnis; cellulæ mediocres subpellucidæ. Flores ♀ terminales, innovati. Bracteæ unijugæ, laxe involucrantes, foliis sat longiores, margine postico crebrius longiusque spinosæ, antico revoluto dentibus 1–3 armato. Perianthia (immatura) immersa cupulata, exalata, ore subbilabiato spinoso-ciliata, aliis ciliis longissimis.—Folia 2.5 $\times$ 1.4, 2.5 $\times$ 1.1, cellulæ $\frac{1}{35}$; perianthia 2.5 $\times$ 1.35^{mm}.

Hab. In Andibus Bolivianis, loco Mapiri alt. 5,000 ped. (sub No. 3,078.)—*P. oresitrophæ*, Spruce, e foliis oppositis affinis, ab illa certe distat foliis angustis paucidentatis, duplo longioribus quam latis.

P. oresitropha, S. Hep. Am. et And. var. Yungas, alt. 4,000 ped. (No. 3,024). A typo Peruviano paulo differt foliis minus crebre ciliatis.

P. gymnocalycina, M. et N. var. subsimplex, Syn. Hep. 32. Yungas, alt. 6,000 ped. (No. 3,048). "In Peruvia locis saxosis humidis sylvarum circa Moleto, et in sylvis excelsis

secus vias prope Chupe prov. Yungas" (Orbigny in herb. Montagne). The much narrower leaves, toothed only toward the apex, seem to mark this for a distinct species; but I have seen no perianths, and dare not separate it. From *P. Mapiriensis* it differs essentially in the alternate (not opposite) leaves.

P. MACRIFOLIA, Tayl. var. Yungas, alt 4,000 ped. (No. 3,051.)

P. RUTILANS, Lindenb. Yungas, alt. 6,000 ped (No. 3,047 p.p).

P. RUBESCENS, Lindenb. Yungas, alt. 4,000 ped (No. 3,018). A few stems mixed with *P. viminea*, n. sp.

P. TENUIS, Lindenb. Yungas, 6,000 ped. (No. 3,060.)

P. BIDENS, Gottsch. Ann. Sc. Nat. (1857). Caules perpauci sterilesque inter alias *Plagiochilas* visi.

PLAGIOCHILA (§SPINULOSÆ) GRACILICAULIS, n. sp.

Dioica, tenuis, flaccida, virescens, caule bipollicari vage paucirameo. Folia distantia, decurvo-subsecunda, basi utrinque (antice præcipue) longe decurrentia, dimidiato-ovato-lanceolata, apice truncato bidentata, dentibus triangularibus, dentulo uno alterove interdum sinu interposito, margine antico recurvo integerrimo vel sub apice 1–2-denticulato, postico prælate sed laxe recurvo (basi integerrima excepta) distanter et breviter spinoso-dentato dentibus omnibus 10-11, cellulæ parvulæ, pellucidæ, inferiores subelongatæ, trigonis vix ullis. Flores ♀ terminales. Bracteæ 2, foliis majores, magis spinoso-dentatæ, antice dentes paucos monstrantes, altera (interior) perianthio subcontigua, altera dissita. Perianthia subemersa cupulato-campanulata, exalata, ore compresso rotundato spinoso-ciliata.—Folia, 2.0×1.0, cellulæ $\frac{1}{40}$; perianthia 2.8×1.8^{mm}.

Hab. Yungas Boliviæ; inter *Plagiochilam Bolivianam* (No. 3,020) exemplaria pauca carpsi.

PLAGIOCHILA (§ASPLENIOIDEÆ) ALTERNANS, Gottsche, Mex. Leverm. 63, t. 7. var. ANGUSTIFOLIA, Spruce.

Dioica, flavo-viridis, caulibus tripollicaribus, assurgentibus, simplicibus vel ramum unum alterumve proferentibus. Folia magna, distiche explanata vel subconvexa, patentissima, late semiovato-oblonga, rotundata, basi breviter late cuneata, margine antico supra medium, postico toto (basi excepta) crebre minute spinuloso-denticulata, dentibus omnibus 25-30; cellulæ

mediocres, subæquilateræ, ad angulos vix subincrassatæ.—Folia 4.3×3.4^{mm}; cellulæ $\frac{1}{28}$–$\frac{1}{20}^{mm}$.

Hab. Prope Yungas Boliviæ, in ligno putrido. (No. 3,010)—*P. asplenioidi* (L.) persimilis, distat foliis crebrius et minutius denticulatis. *P. ovata*, G. et *calomelanos*, Spruce, folia basi semicordata, toto margine minute denticulata habent.—Ad eandem speciem referenda erit plantula in Costa Rica a cl. E. S. Hyde lecta; parum divergit caule ramosiore, foliis angustioribus (4.5×2.5^{mm}) sæpe decurvo-convexis, cellulis paulo majoribus; margine autem eodem modo denticulatis ceterisque caracteribus cum stirpe Boliviana congruit. Stirps originalis Mexicana folia habet rotundiora, numero dentium tamen, &c., &c., cum nostris bene convenit.

P. (Grandifoliæ) adiantoides, vars.—Yungas, alt 6,000 ped., Unduavi, alt. 8,000 ped. (Nos. 3,010, 3,012, 3,013, 3,015, 3,016, 3,021, 3,047 pro parte).—Some of these forms, notably Nos. 3,012, 3,013 and 3,021, approach the West Indian "*P. superba*," but are hardly separable from typical *P. adiantoides*; and the "*P. superba*" gathered by d' Orbigny "in Boliviæ locis udis silvarum inter Chupe et Yanacache" doubtless belongs to the same category. The original *P. superba*, founded by Nees on a plant gathered in the Mauritius by Sieber, however, seems distinct.

P. Notarisii, Mitt. Yungas, alt. 4,000 ped. (Nos. 3,009, 3,011, 3,014). Cum forma æquatoriali archetypa convenit foliis prælatis, semicordato-triangularibus, paucidentatis, necnon perianthiis immersis late alatis, &c.; solum differt foliis paulo longioribus obtusioribusque.

P. heteromalla, Ldng. var. foliis latis circumcirca fere denticulatis, dentibus sub 70. Mapiri, 5,000 ped. No. 3,019. The three forms described in Hep. Am. et A., distinguished namely by differences in the breadth of the leaves and in the degrêe of marginal dentation, belong to but one species. The toothing of the anterior margin is variable but never entirely disappears (as asserted by Lindberg). The presence or absence of a wing to the perianth is inconstant in all the forms.

Plagiochila (§ Heteromallæ) implexa, L. et G. Hep. Mex. 76, t. XIII. Dr. Rusby gathered this species, mixed with

Herberta serrata, n. sp. at Unduavi (alt. 10,000 ft.), but only the male plant. It belongs to the § Heteromallæ, and agrees well with the description and figure in Gottsche's work. The leaves are smaller than in most of its congeners (1.2×1.0^{mm}) strongly secund and accumbent, suborbicular, but with the whole antical margin so strongly revolute that they seem almost dimidiate. The rounded, plane, postical margin is closely spinuloso-dentate, teeth about 20. Cells minute and opaque, thick-walled and sub-equilateral, but near the axis in the lower half less minute and twice as long as broad. ♂ spikes medial and terminal, ovato-fusiform; bracts monandrous.

Liebmann discovered this species on the volcano Orizaba, at 8 to 12,000 feet, or at nearly the same height as Rusby found it in the Bolivian Andes.

PLAGIOCHILA (§ HETEROMALLÆ) FRAUSA, Gottsch. var. BOLIVIANA, n. var.

Dioica, cæspitosa, rufo-flavens; caules 1–2-pollicares, stricti, ramos paucos alternos proferentes. Folia subimbricata, plus minus decurvo-secunda, subtransversa, basi utrinque (antice præcipue) decurrente amplexantia, prælate semiovato-triangularia (potius deltoidea) acuta, margine antico stricto, late (non autem valide) recurva, unde folia canaliculata ab infero visa, integerrima vel sub apice 1–2-dentata; postico (basi longa integra excepta) valde rotundato spinuloso-dentata, dentibus omnibus sub 12, brevibus peracutis; cellulæ parvæ, opacæ, trigonis auctæ.—Folia 1.8×1.5, cellulæ $\frac{1}{50}$.

Hab. Yungas Boliviæ, alt. 6,000 ped. (No. 3,048 p.p.)—*P. deltoidia*, Lindng., e Nova Zelandia, huic persimilis, folia habet majora, magis dimidiata, margine postico ab ipsa fere basi validius dentata. *P. Bahiensis* Lindng. caule flagellifero, foliis utroque margine apiceque rotundatis distat. In nostra, alii rami interdum videntur exparte exfoliati, pro flagellis autem vix habendi. *P. frausa* typica, Mexicana, folia habet paulo longiora, magis argute dentata, alioquin omnino conformis est.

PLAGIOCHILA (§ HETEROMALLÆ) VIMINEA, n. sp.

Dioica, elata, flavo-viridis, caulibus 2–3-pollicaribus, cæspitosis, e basi decumbente suberectis, strictis et quasi vimineis, subsimplicibus, raro fastigiato-ramosis, valde polyphyllis. Folia

parva, inbricatula vel solum contigua, plus minus decurvo-secunda, semicordato-rotunda, margine antico rectiusculo late recurvo longe decurrente integerrima, postico prælate rotundato recurvo-cristato apiceque rotundato distanter spinuloso-dentata, dentibus 6–10; cellulæ parvulæ, convexulæ, ambitu late opacæ, incrassatione angulari nulla.—Folia 1.9^{mm} longa (ab ipsa basi antica), 1.3 (a basi postica), 1.6 ^{mm} lata, cellulæ $\frac{1}{40}$^{mm}.

Hab. Bolivia, in prov. Yungas (No. 3,018) *P. bifaria* (Sw.) differt foliis angustioribus, ovato-oblongis, apice sæpe bicuspidatis.

PLAGIOCHILA (§FRONDESCENTES) RUSBYI, n. sp.

Dioica, elata, rufo-brunnea; caules e caudice repente a matrice liberi (penduli ?) tripollicares, ab ipsa basi eleganter pinnati, pinnis sub 12 cujusque lateris, brevibus (mediis ¼ pollicis longis), frondem lineari-lanceolatam sistentes. Folia latiuscule imbricata, patentia (ramea ad angulum acutum), utrinque basi longe decurrentia, late semiovata, subtriangularia, apice obtusa truncatave, margine antico recurvo sub apice 2–3-dentata, cæterum integerrima, postico (basi excepta) apiceque spinoso-dentata, dentibus omnibus numero 10-15, breviusculis, late subulatis, inæqualibus; cellulæ parvulæ, opacæ, pachydermes, mediæ axialesque paulo longiores. Foliola nulla. Flores non aderant.—Folia 1.8×1.25, cellulæ $\frac{1}{40}$.

Hab. In Andibus Boliviæ orientalibus, loco Mapiri (alt. 5,000 ped. m. Aprili, 1886 (No. 3,031).—*P. thyoides*, Hep. Am. And. huic subsimilis, elatior est; foliis magis confertis, longioribus, solum apicem versus spinuloso-denticulatis; foliolis posticis majusculis adjectis.—*P. abietina*, Nees, differt caule fibrilloso, foliis tota fere longitudine argute spinoso-dentatis.

PLAGIOCHILA (§ FRONDESCENTES) LIGNICOLA, n. sp.

Dioica, virescens, elata, caule tripollicari et ultra, robusto, pinnato et subbipinnato. Folia flaccida tenuia imbricata, distiche patentia, semiovato-triangularia, obtusata vel truncata, utrinque leniter recurva, basi haud longe decurrentia, dein postice sub abrupte dilatata et rotundata caulem transeuntia et vel appressa vel cristatim recurva, margine supra medium—antico sæpe solum versus apicem—denticulata, dentibus pro more parvis inæqualibus (numero circiter 12); cellulæ parvulæ pellucidæ, trigonis subnullis. Foliola nulla.—Folia 2.3×1.5, 2.0×1.2, cellulæ $\frac{1}{40}$^{mm}.

Hab. In situ Yungas Boliviæ, alt. 6,000 ped. ad ramos emortuos. (No. 3,022).—*P. deflexirama*, Tayl. distat caule duplo

longiore, ramis subsimplicibus, foliis semiovato-oblongis validius spinoso-dentatis.

PLAGIOCHILA (§ FRONDESCENTES) RUFOVIRIDIS, n. sp.

Dioica, e viridi rufescens, caule sesquipollicari pinnato, ramis rarius ramulum proferentibus. Folia imbricata, distiche patentia, semiovato-oblonga, basi subsemicordatâ caulem velantia vel recurvula, margine antico recurvo decurrente integerrimo vel denticulis 1–3 distantibus armata, postico distanter spinoso-dentata, apice subtruncato plerumque 4-dentata, dentibus omnibus 12–15 inæquilongis. Flores ♀ in ramis terminales. Bracteæ foliis subconformes, appressæ, antice serrulatæ, postice apiceque crebrius longiusque spinoso-dentatæ. Perianthia vix emersa, cuneata, compresso-obconica, oblique subtruncata, hinc ala perangusta integra percursa, ore dentibus parvis, crebris, brevi-subulatis armata.—Folia 2.5×1.35 cellulæ $\frac{1}{32}$; perianthia 3.0×1.8^{mm}.

Hab. Yungas Boliviæ, aliis Plagiochilis et Lejeuneis immixta. (No. 3,050 p. p.) Stirps solitaria mihi adevat, ab affinibus omnibus sc. *P. distinctifolia*, cet., diversa videbatur.

P. DIVERSIFOLIA, L. et G.—Yungas, alt. 6,000 ped. (No. 3,063, 3,050 p. p.)

P. LÆTEVIRENS, Lindenb. var.? Mapiri, alt. 5,000 ped. (No. 3,077).

P. DISTINCTIFOLIA, Lindenb. Yungas, alt. 4–6,000 ped. (No. 3,049, 3,050 p. p.)

P. XANTHOCHROMA, Spruce, Hep. Am. et And. Yungas, alt. 6,000 ped., fertilis. (No. 3,050 p. p.) As Dr. Rusby's specimens, although *very* few, possess good perianths, which were wanting in those I took as the type of the species, I add a brief description. As in the plant of Ecuador so in that of Bolivia, the leaves rapidly discharge their yellow coloring matter on being steeped in water, and remain quite bleached.

Folia utroque margine late recurva, in sicco tam revoluta ut distantia et pectinata videntur; alia apice bifidula, segmentis subspinuloso-denticulatis. Cellulæ materie colorante in aqua cito evacuatæ scariosæ restant.

Flores ♀ in ramis terminales. Bracteæ subbijugæ, basi perianthium amplectentes, dein late patulæ, foliis paulo majores, margineque postico magis spinosæ. Perianthia emersa, cuneata, compressa, exalata, ore obliquo subrotundato-truncato crebre

longeque dentato-spinosa.—Folia 2.65×1.1, 2.5×0.8, cellulæ $\frac{1}{25}$ bracteæ 3.1×1.35; perianthia 3.25×1.5^{mm}.

P. CRISPABILIS, Lindenb. Mapiri, alt. 5,000 ped. ♂ (No. 3,032).

PLAGIOCHILA (§ CRISTATÆ) BOLIVIANA, n. sp.

Dioica, flavicans, caule bipollicari, valido basi rhizomatoso, parce ramoso, ramisque flexuosis polyphyllis. Folia dense imbricata, distiche patentia, raro decurvo-secunda, prælate semiovata, truncato-3–5-(plerumque 4-) dentata, rarius rotundata; margine antico recurvo, subrecto, integerrimo, longisime decurrente; postico basi primum recto horizontali dein late rotundato integerrimo, cauli appresso vel sæpius cristato-recurvo, cetero margine paucidenticulata, dentibus parvis inæqualibus numero 10–15; cellulæ parvulæ subopacæ, pachydermes trigonis angularibus magnis. Foliola minuta, caule velata, polymorpha, nunc lineara bifida, nunc ad basin usque in lacinias 2–3 capilares fissa &c. Andræcia in medio ramo posita; bracteæ plurijugæ, foliis minores, julaceo-imbricatæ.—Folia 2.3×1.9, 1.8×1.4, cellulæ $\frac{1}{26}^{mm}$.

Hab. Ad Yungas Boliviæ alt. 6,000 ped. (No. 3,020). *P. punctualis*, G. Hep. Mex. 57. t. 10, huic similis differt colore viridis foliis longioribus et sat angustioribus, paulo magis dentatis, foliolis majoribus plurifidis.

P. ORBIGNYANA, Mont. Mapiri, alt. 5,000 ped. (No. 3,065) "In locis udis, ad radices Andium orientales loco, Moleto dicto, ad cortices arborum." (D'Orbigny).

LEIOSCYPHUS, Mitt.

L. SCHIZOSTOMUS, S. in Hep. Am. et And. 446. Yungas, alt. 4,000 ped. (No. 3,055). Etiam cum *Lejeunea filiformi Plagiochilisque* haud raro commixta.

LOPHOCOLEA, Dumort.

L. MURICATA, Nees. In *Lej. filiformi* (No. 3,069) rarissime repens.

L. TRAPEZOIDEA, Mont. Frustula sola inter *Plagiochilas* raro inventa.

LOPHOCOLEA QUADRIDENTATA, n. sp.

Dioica, luride purpurea, prostrata, caule pollicari vel longiore, vage paucirameo. Folia opposita, arctiuscule imbricata, hori-

zontalia, convexa, oblongo-quadrata apice truncato biapiculata, sinu lato recto vel parum lunato, margine antico stricto integerrimo, postico apicem versus leniter rotundato, ibidemque dentibus ciliisve 2 dissitis armato; dentibus omnibus 4, subæquidistantibus, subulato-setaceis, apicalibus 4 cellulas, lateralibus 7-9 cellulas longis; cellulæ medii folii majusculæ, subapicales duplo minores, omnes leptodermes pellucidæ. Foliola utrinque cum folio connata, profunde bifida, dein quadrifida, laciniis foliis plus duplo brevioribus, subulatis, flexuoso-acuminatis, divergentibus, integerrimis vel paucidentatis, laciniis 2 basalibus reflexis interdum adjectis. Flores ♀ in caule ramove terminales (juveniles). Bracteæ foliis validius dentatæ; bracteola maxima, primum bifida dein plurilaciniata laciniis subtortis. Pistillidia plurima subelongata. Perianthia —. Folia 2.5×1.8; cellulæ $\frac{1}{34}$; folioli laciniæ 1.0^{mm}.

Hab. In Andibus Bolivianis, alt. circiter 6,000 pedum, ut videtur sat frequens, ad rupes humidas cum *Sphagnis*, *Plagiochilis*, etc. repens; solum sterilis visa—(No. 3,008, 3,074).—Ad ramos tenuiores dens quartus s. infimus interdum deëst, et folium solum tridentatum fit, dentibus etiam abbreviatis.—A *Chiloscypho arguto*, N., insulis Malayanis etc. indigeno, quocum commutata fuit, tam generice quam specifice differt.

JUNGERMANIA.

JUNGERMANIA OPPOSITIFOLIA, n. sp.

Dioica, cæspitosa, inferne virescens, apice rosea; caules 1-2 pollicares graciles, subsimplices, subtus ad foliorum insertionem radicellis brevibus pallidis obsessi. Folia subimbricata, vel vix contigua, opposita nisi pro basi antica breviter decurrente fere transversa, assurgenti-secunda, laxe accumbentia, oblongo-orbiculata, leniter concava, integerrima, cellulæ parvulæ, subæquilateræ, facie tuberculoso-asperulæ, trigonis angularibus magnis. Foliola nulla. Flores — Folia $.8 \times .65$, cellulæ $\frac{1}{40}^{mm}$.

Hab. Bolivia, prov. Yungas (No. 3,045).—Folia plerumque exacte opposita, raro basi subconnata; solum in caulibus tenuioribus videntur folia superiora interdum subdislocata.—Cum *J. colorata* congruit habitu colore, &c.; multo tenuior tamen, foliis oppositis (nec alternis) minus decurrentibus, &c.

NOTEROCLADA, Tayl.

NOTEROCLADA ARHIZA, n. sp.

Dioica, virens, in ætate rubescens, caule 1-½ pollices longo,

subsimplice, in matrice arcte repente, prælato, tenui tamen, supra plano vel subdepresso, subtus vix convexulo et vel omnino arhizo vel raro e foliorum basi radicellas paucas minutas proferente. Folia plano-disticha, parum imbricata, succuba fere longitudinaliter inserta, inferiora latiora quam longa, ovato-rotunda, subapicalia paulo longiora et angustiora, oblique oblonga magisque erecta, omnia cellulis bistratis pro majore parte (medio præcipue) conflata; cellulæ magnæ, pellucidæ, superiores subæquilatero, 4-7 gonæ, mediæ inferioresque oblongatæ. Flores ♀ terminales (valde juveniles solum visi).—Folia 3.1 × 3.8, superiora 4.3 × 2.8, cellulæ subapicales $\frac{1}{16}^{mm}$.

Hab. Sorata alt. 10,000 ped., cum *Marchantia* mixta, sterilis. (No. 3,005 p. p.)—The few species previously known of this curious genus are notable for their numerous, long, thick radicles, in one species purple, in another white; but in this plant, which exactly accords with the other species in the character of its foliage, the stems are either entirely rootless or shew rarely one or two small fascicles of radicles reduced to mere papillæ.

SYMPHYOGYNA, Mont.

S. Brasiliensis, Mont. var. Yungas alt. 6,000 ped. (No. 3,059).—Specimens from South Brazil, and others from the Quitenian Andes, have the fronds mostly thin and unistratous nearly or quite up to the midrib; but in these of Dr. Rusby's, and others from the Antilles, the pagina is thickened for about half its breadth, 4 cells thick next the midrib, thence gradually thinning out; yet intermediate states occur. In color, the fronds vary from whitish-green to olive-purple—almost black on the midrib.

S. leptothelia, Tayl.? Yungas, alt. 6,000 ped. (No. 3,007 a).

S. Brongniartii, Mart. Frondes perpaucæ steriles inter *Plagiochilas* visæ.

METZGERIA, Raddi.

M. hamata, Lindberg. Yungas, alt. 6,000 ped., fertilis. (No. 3,007 b).

ANEURA, Dumort.

A. (multifidæ affinis, sterilis). Sorata, &c. (No. 3,005 p.p. &c.)

DUMORTIERA, Nees.

D. HIRSUTA, N. var. IRRIGUA. Yungas, alt. 4,000 ped. (No. 3,006).

MARCHANTIA, L.

M. PLICATA, Nees? Sorata, alt. 10,000 ped. (No. 3,005).

M. CHENOPODA, L. Pl. ♀ fertilis. Yungas 4,000 ped. (No. 3,004); pl. ♂ eodem loco, Nos. 3,001, 3,002, 3,003.

M. *nova species*? Sorata, sterilis, cum *Noteroclada*, (No. 3,005).

AITONIA, Nees.

A.? *species*, sterilis. Sorata, alt. 13,000 ped. (No. 3,000).

FIMBRIARIA, Forst.

F. *species*, sterilis. Mapiri, alt. 5,000 ped. (No. 3,088).

GENERIC INDEX.

Aitonia 140
Aneura 139
Bazzania 129
Cephalozia 131
Dumortiera 140
Fimbriaria 140
Frullania 118
Herberta 128
Isotachis 128
Jungermania 138
Leioscyphus 137
Lejeunea 121
Lepicolea 129
Lepidozia 130
Lophocolea 137
Marchantia 140
Metzgeria 139
Noteroclada 138
Plagiochila 131
Radula 126
Scapania 128
Symphyogyna 139

[Issued January 20th, 1890.]

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. I. NO. 4.

ON SEEDLESS FRUITS.

BY E. LEWIS STURTEVANT.

ISSUED MAY 30TH, 1890.

PRICE, 75 CENTS.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

Vol. I. No. 4.

SEEDLESS FRUITS.

By E. Lewis Sturtevant, South Framingham, Mass.

If we seek in nature an occurrence which is distinctly prejudicial to the continuance and distribution of species, we find an illustration in seedless fruits. Unless correlated with a development or increase of other means of propagation, as by suckering, off-shoots or bulbs, seedlessness must eventually bring about the destruction of the variety which its advent marks. Hence, seedlessness is more apt to be noted in cultivated or protected plants. In nature we would suppose that seedless fruits would necessarily be confined to the restricted locality wherein they have originated, for it is only under man's care, as it would seem, that they can receive a general distribution, although the habit of a species towards seedlessness may cause similar variety originations in different localities. Hence it is with extreme surprise that we note the wide extension of *Acorus Calamus*, a plant that so rarely perfects its fruit that this has been seen by but few botanists.[1] Yet sterility is but the extreme of the partial sterility, or more or less fruitfulness, which is so constantly noted, and we cannot consider the causes of one without more or less considering the causes of the other.

The causes of sterility, either partial or complete, must be many and complicated. The various factors combined under the term season are an influential series, as we note the increased fruitfulness of various wild fruits in one season as against another;

1 Darwin, An. and Pl. ii. 207.

as for illustration, the dangle-berry, (*Gaylussaccia frondosa*) in a Massachusetts locality, bore little fruit in 1888, the bloom failing to form, while in 1889, in the same locality the shrubs were extremely prolific. We find excellent illustration of the effect of climate in Humboldt's statement that on the slopes of the mountains of Mexico and Xalapa, at 677 toises of height, the luxuriance of vegetation is such that wheat does not form ears ; and in India, Firminger notes quite a large number of plants that rarely blossom or seed, such as *Convolvulus tricolor*, *Geum atrosanguineum*, *Hibiscus Rosa-Sinensis*, *H. liliiflorus*, etc. Brandis in his Forest Flora names also the *Populus alba*, *Bambusa Balcova*, etc., and Seemann in the Feejee Islands the *Dioscorea alata*. Such instances could be almost indefinitely extended. A correlation between tuber bearing and seeding also seems to exist. Thus the *Agave vivipara*, when grown in rich soil in India invariably produces bulbs, but no seed, while on a poor soil and under arid conditions the opposite result occurs.[1] The sweet potato in China, according to Dr. Fortune,[2] never yields seed ; in our region the sweet potato never blossoms, or if at all very rarely, yet in Alabama it blossoms, but, as Dr. Newman writes me, when forwarding the bloom, that he had never known seeds to be formed. The potato was noted by Knight[3] as having varieties that do not bloom, and at the present time the majority of our cultivated varieties, while blooming freely, yield no fruit or seed. The sugar cane rarely seeds, and Darwin quotes testimony that it never seeds in the West Indies, Malaga, India, Cochin China or the Malay Archipelago, yet recently at Barbadoes sugar cane has seeded and the seed has yielded seedlings[4]. A most interesting case of barrenness has come under my own observation at Nonquit, Massachusetts, where a gold-striped form of *Spartina cynosuroides* has been sterile for two years, while the ordinary green form alongside has seeded abundantly. Hybridity may also be ascribed as a cause, and Darwin cites a number of instances, and quotes Kolreuter as expressing astonishment that

---

1 Royle. Trans. Linn. Soc. xvii. 563.

2 Darwin An. and Pl. ii. 206.

3 Hort. and Phys. papers, 321. Goodrich, Trans. N. Y. Ag. Soc. 1847, 447.

4 Agricultural Science, March, 1889, p. 58.

hybrids are not only frequently sterile, but show a strong tendency to develop gigantic or tuberous roots, and as almost invariably tending to increase largely by suckers. We must not, however, ignore those obscure observations wherein we note an influence of pollen in developing the ovarium, although incapable of developing the ovule, and Darwin's statement that "with an orchid, the *Bonatia speciosa*, the development of the ovaria could be effected by mechanical irritation of the stigma" has not received the attention from investigators that its importance deserves. Gærtner often insists, says Darwin, that the flowers of uttterly sterile hybrids, which do not produce any seed, generally yield perfect capsules or fruit, a fact which Naudin has repeatedly observed in the Cucurbitaceæ. It seems to be well ascertained that certain plants can produce not only fruit, but fertile seed, without having been subjected to the action of pollen. Thus, as good authorities as Quatrefages[1], says this is unquestionably true, and Hooker[2] quotes facts of this character from Spallanzani, Bernhardi, Ch. Naudin, Fresenius and Tenore, and Jussieu[3] and Darwin[4] express also their belief. Treviranus[5], however, states that a perfect development of fruits, but with barren seeds will take place with some plants without the process of fertilization.

There seems to exist in fruits a correlation between seedlessness and quality, especially when that quality is expressed by the term tenderness of tissue. In fruits of a fine quality, tenderness of the seed coating often seems a marked characteristic, as in grapes, where the seeds of the improved varieties are distinctly softer and more brittle than in those of the wild species; as in peaches and plums, where the tendency of a split stone is often noticeable in fruit of varieties of high quality. It certainly should not be overlooked that universal experience usually recognizes lack of hardiness in trees of the most highly improved and developed varieties. This idea of correlation between seedlessness and quality is by no means a new one. Thus Bacon[6] wrote,

---

1 Quatrefages, Metamorphoses of Man. 271.
2 Hooker, Journ. of Bot. ix. 53.
3 Jussieu, Cours element. de Bot. 1840, 463.
4 Darwin, An. and Pl. i. 484.
5 Lond. Hort. Soc. Trans. 1854, 112.
6 Bacon's Works, Bohn. Ed. i. 142.

(born 1651): "The making of fruits without core or stone is likewise a curiosity, and somewhat better, because whatsoever maketh them so, is like to make them more tender and delicate." With such authority is it surprising that the "Christian Advocate,"[1] properly a disciple of humanism or idealism rather than of realism, soberly says: "Fruit of all kinds may be grown without seed by reversing the cion—rooting the top end of the cion. * * * Apples are grown without cores, peaches without seed, and grapes, plums, cherries, blackberries and every other kind of fruit may be grown without seed by simply reversing the cion. Persimmons without seed are not to be excelled by any other fruit in this country when dried. Apples cooked without cores are delightful. Grapes have been raised for five thousand years without seed. Peaches dried whole without seed would be a hundred times better than those shaved up and dried. The seeding of cherries has been a great trouble to cooks." ! !

The taking the pith from the vine in order to produce seedlessness, received the approval, if not the trial, of the ancients, as we find directions from Democritus, Palladius, Columella, and the well-read Bacon[2].

In the present stage of this investigation, I prefer to give such facts and statements regarding seedlessness, mostly in fruit, used in the horticultural sense, that have come to my attention, allowing the facts to speak for themselves. If such a correlation between quality and seedlessness exists, as I infer, this presentation has a value in calling attention to a possible method whereby our cultivated fruits may be more improved, and wild fruits be more successfully brought into cultural use.

It may be proper to call attention in advance to the fact that as regards size of fruit, there seems to be no way of generalizing at present. In the bunches of our cultivated grapes the larger berries contain usually the most seed; in the banana, increase of size apparently accompanies seeding, and the opposite conclusion is stated by Balfour also in relation to the breadfruit as well as the banana.[3]

1 Quoted in the New York Analist, Sept. 1, 1885.

2 Democritus, Geopon. lib. 4, c. 7. Palladius, De re rust. Feb. c. 29. Columella, De arb. c. 9. Bacon, notes, l. c.

3 Balfour, Bot. 261.

Apple. Pyrus malus, L. (Rosaceæ).

The apple is a fleshy fruit consisting of the ovary and calyx. The outer skin or epicarp is composed of the epidermis of the calyx combined with the ovary; the fleshy portion is the mesocarp, formed by the cellular portion of the calyx and ovary; while the scaly layer forming the walls of the seed-bearing cavities in the centre, is the endocarp. The carpels lie towards the centre of the fruit and form the core, while the edible pulp is formed by the calyx, which is adherent to the exterior of the ovary.

The better varieties of the apple usually contain some abortive seeds, and are sometimes individually to be found seedless. As a rule, where there is a tendency to abortive seeds, the larger and finer the apple the greater the number of abortive seeds. Thus five Baldwin apples, weighing thirty ounces, had eleven plump and nine shrivelled seeds; five others from the same barrel, and weighing seventeen ounces, furnished twenty-five plump and three abortive seeds.

The ancients were acquainted with the fruits of but limited areas as compared with our knowledge of to-day, for transportation and travel were then difficult. However, a goodly number of varieties are named. Pliny[1] gives the names of seventeen kinds as known to the Romans. In the sixteenth century Cordus[2] describes thirty-four German sorts; Le Jardinier Solitaire, 1612, describes ten French varieties; Parkinson, in his Paradisus, 1629, names or briefly describes fifty-seven sorts; J. Bauhin, in 1650, figures fifty-nine varieties and describes seventy-four; Rea, in his Flora of 1665, describes twenty sorts; Ray, in his History, 1688, names seventy-eight; Quintyne, in the English edition of his Compleat Gardener, 1693, catalogues twenty-five; Zwingerus, in 1696, in his Kreuterbuch gives a list of two hundred and thirty-four apples; Langley's Pomona, 1729, describes thirty-nine; Miller's Dictionary, 1731, commends forty kinds; Knoop's Pomologia, 1760–'66, gives colored figures of two hundred and fifteen; Mawe's Gardiner, 1778, enumerates sixty-seven varieties; Don, in 1832, offers a list of one thousand three hundred and ninety-six distinct apples; Downing, in 1866, notices six hun-

1 Pliny, lib. xv. c. 15.

2 J. Bauh. Hist. 1650, i. p. 5.

hred and forty-three kinds; and the American Pomological Society in 1877, approves for culture three hundred and twenty-two apples and thirteen crabs.

Seedless apples were known to the ancient Greeks[1], and the Romans,[2] called such the *spadonium* of the Belgae. In the twelfth century, Ibn-al-awam[3], a Moorish-Spaniard, cites Abou'l-Khari, of Seville, who describes the *Schahaly* apple as producing no flowers, and the fruit containing no seed. Camerarius[4], in 1588, mentions apples without seed, but also quotes Throphrastus; Bauhin,[5] in 1623, quotes Camerarius, and the apple not flowering, yet fruit-bearing of Gesner, which doubtless was seedless. Parkinson,[6] in 1629, speaks of the "apple without bloom" neither a good eating nor baking fruit, and in 1640[7], speaks of the *Poma nana*, the same name Camerarius uses, as having no kernels within the core. In 1650 we have Gesner and Camerarius quoted by John Bauhin, the former describing his tree in the vicinity of Tiguri, the latter as *Poma nana*, and a wood-cut of the *Malus non florida dicta*, which he states is wont to be seedless.[8] This same figure, not accurately copied, is given by Jonston[9] in 1662, who apparently had not seen the variety, and a better copy by Chabraeus[10] who claims to have seen the fruit in the garden under charge of J. Bauhin; he calls it *Malus non florida dicta*, Gall. *Pommier sans fleur*. In 1665 the Hort. Reg. Paris, as quoted by Miller[11] had the *Malus fructifera, flore fugaci*, or fig apple. He had not seen a specimen himself, but refers to a letter written from New England by Paul Dudley, and published in the Phil. Trans. No. 385, as being of this kind. This letter[12] says, "This tree was no graft, and the fruit but ordinary

1 Theoph. de caus. pl. lib. 3 c. 23.

2 Pliny, lib. xv. c. 15.

3 Le lirve de l'Agric. d' Ibn-al-awam. Trad. par J. J. Clement Mullett, Paris, 1864, i. 308.

4 Cam. Hort. 1588, 95.

5 Bauh. pin. 1623, 433.

6 Park. par. 1629, 588.

7 Park. theat. 1640, 1502.

8 J. Bauh. Hist. 1650. i. 22.

9 Jonston, dend. 1662, p. 2, t. 2.

10 Chatraeus, stirp. sciag. 1677, p. 1; also ed. of 1666, p. 1.

11 Miller, Gard. Dict, 1731, art. malus.

12 Phil. Trans. 1724, 200.

for taste." In 1719 Tournefort[1] makes like reference to the Paris Garden, and gives as synonyms the *Malus non florida dicta* of J. Bauhin, and the common name *Pomme figue*. In 1768 Duhamel[2] describes the same variety, and in his second edition gives a figure of the fruit. In 1834 there was exhibited at the Massachusetts Horticultural Society's exhibition,[3] from Shrewsbury, Massachusetts, "A curious apple produced without blossoms, and having neither core nor seed." October 13, 1888, some "No Blow" apples were brought to the society by Mr. L. C. Durkie, of Northfields Farms, and these were identical in shape, but a little redder in color, than Duhamel's figure. I secured good colored drawings and dissections, and found them double-cored and seedless. The taste acid, crisp, sprightly, reminding of the Porter apple. December 15, 1888, O. B. Hadwin, of Worcester, informed me that the Shrewsbury seedless apple was well-known to him, and was the same variety as the "No Blow."

In 1778 Mawe[4] describes the Fig apple, and accounts for the name by the trees producing fruit without any visible flowers, like the Fig, but he adds that the tree does produce flowers that are visible, but almost apetalous. The *Pomme figue* is described, with Bauhin's and Tournefort's names as synonyms by Poiret[5] in 1804, and under the names *Pomme figure sans pepin* and *Pomme d'Adam* by Noisette[6] in 1829, who describes it as yellow striped with pale red, with firm and acid flesh. This fruit is also referred to by Ray,[7] in 1688, who but quotes from Bauhin's Pinax, and apparently by Joncquit, in 1659, under the name *Malus fructifera sine flore d'Robin*.

From this review it seems placed among the strong probabilities that many of these seedless apples were one and the same variety which has been continued through the years, and if so, illustrates either that it occasionally produces seed which continues the variety, or else that the present trees have been continued from grafts for over two thousand years.

---

1 Inst. rei herb. 1719, 635.
2 Duhamel du Monceau, arb. fruit, 1768, i. 318; 2d ed. i. pl. 28.
3 Hist. Mass. Hort. Soc. p. 234. Mass. Hort. Soc. Rept. 1834, 22.
4 Mawe and Abercrombie, Gardener, under *Pyrus*.
5 Enc. method. bot. v. 562.
6 Noisette, Man. du Jard. 1829, 437.
7 Ray, Hist. 1688, ii. 1446.

Other remarks on seedless apples are those of Darwin,[1] who speaks of the curious St. Valery apple, in France, which although it bears fruit, rarely produces seed; that of the Bon Jardinier[2], which describes the *Sans Trognon de Menocher*, an excellent winter apple of the valley of Digomier, of which is said: "We do not know of a finer apple; it is well named coreless, for it has nothing within the skin which resembles a core, neither seed nor seed cells; it is excellent, of large medium size!"

As to causes, the apple becomes seedless in Jamaica according to Lunan,[3] apparently the effect of climate. In Knight's[4] experiment of grafting the apple on the pear, the fruit was seedless. In 1882 some Carolina Red Sour apple trees bore a second crop in Georgia, and these were seedless; "There was not the least evidence that any embryo had ever been present in the core or cavities of the endocarp."[5]

In a case reported in France[6] of a seedling apple one-half of which was red and acid, the other half green and sweet, suggesting hybridization, there was said to be scarcely ever a perfectly developed seed.

In counting the seed of a number of variety of apples, the following figures were obtained.[7]

Variety.	*No. of Specimens.*	*Average No. of Plump Seed.*	*Average No. Total Seed.*
Baldwin,	67	3.73	5.74
Bellefleur,	5	9.5	11.5
" Yellow,	2	8	8
Blue Pearmain	3	12	12.66
Greening,	1	4	7
" naked limb	1	10	10
" Palmer	1	3	3
" Rhode Island	6	6.87	11.21
" Winthrop	1	6	7
Gilliflower,	3	5	7
Grimes' Golden,	1	10	10

1 Darwin, An. and Pl. ii. 203. See also Bailey, The Bloomless Apple, Am. Garden, Jan. 1890, 6.

2 Bon Jardinier, 1882, p. xlvii.

3 Lunan. Hort. Jam. p. 24.

4 Phys. and Hort. Papers, 222.

5 Country Gentleman, Nov. 30, 1882.

6 Loudon's Gard. Mag. xiii. 230.

7 N. Y. Ag. Ex. Sta. Rept. 1882, 82; Proc. Soc. for P. of Ag. Sc. 1881, 114.

Variety.	*No. of Specimens.*	*Average No. of Plump Seed.*	*Average No. Total Seed.*
Hubbardson,	4	3.75	6.33
Hyde,	2	8.5	8.5
Jelly,	1	8	8
King of Tompkins County,	3	7.6	8.6
Lady Apple,	2	7	7
Northern Spy,	4	12.75	13.75
Pippin, Golden	2	4	7
" Monmouth	1	8	8
" Newtown	1	1	10
" New York	1	10	10
Russet,	1	6	8
" English	1	9	9
" Golden	3	3	7
" Gray	1	1	6
" Roxbury	4	3.25	8.66
Seek no Further, Westfield	1	16	18
Smith's Cider,	1	9	9
Spitzenburg,	3	6	7.6
" Esopus	6	10.7	11.1
Swaar,	1	13	13
Tolman Sweeting,	8	7.7	8.7
Vandevere,	1	9	10
Willow Twig,	1	10	11
Winter Blush, Tewksbury,	1	6	6

AVOCADO PEAR. PERSEA GRATISSIMA, GÆRTN. (LAURACEÆ).

There are several species or varieties of this fruit. Morelet[1] describes them in Central America; the *avocate*, the *omtchon*, and a third called *anison* on account of its flavor. In the normal plant the fruit is of the size of a large pear, and contains a large oval stone, which rattles when the fruit is ripe; the pulp is of a delicate coffee color, unctuous, without odor, resembling fresh butter. Long[2] mentions a green and a red sort in Jamaica.

In Ceylon the fruit is said to be smaller, harder, less buttery, thicker skined and more stony than in other climes.[3]

I introduce this statement among seedless fruit on account of the decrease of quality accompanying the *stony* seed, whatever that may mean.

---

1 Travels, p. 265.

2 Jamaica, p. 808.

3 H. L. C. Gard. Chron. Apr. 19, 1884, p. 520.

Azarole. Cratægus Azarolus, L. (Rosaceæ).

This fruit is usually two-seeded, and when fully ripe is said to have an agreeable taste. It is esteemed in Italy and the Levant, where it is served at dessert. It is said to be much cultivated[1]. The fruit is cherry size, and is a pome resembling a very small pear. Duhamel,[2] says there are numerous varieties, the small yellow fruited, the small red fruited, and the large deep red fruiting. Noisette[3] mentions as varieties the fruit *longes*, *rouges* and *jaunes*.

Athenaeus[4], a Greek author of the second and third century, speaks of the Azarole as sweet and seedless. Darwin[5] mentions this plant amongst those in which the best varieties bear none or few seed.

Banana. Musa, sp. (Musaceæ).

The banana is a prominent instance of a seedless fruit. The fruit is composed of three adherent carpels surrounded by the external coat of the ovarium. There are very many varieties. Rumphius[6] says there are as many different kinds as there are of apples and pears in Europe. There are no fewer than thirty varieties cultivated by the natives of Tahiti, according to Ellis[7], besides twenty kinds, very large and serviceable that grow wild in the mountains. In Feejee, Wilkes[8] mentions five or six kinds besides the wild form, as cultivated. In India, Mueller[9] says about fifty distinct kinds are grown, and Firminger[10] enumerates twenty-one sorts under five species. Carey[11], however, says the cultivated varieties are infinite. Simmonds[12] estimates twenty varieties in Tenasserim, ten in Ceylon and thirty in Burmah.

---

1 Bot. Reposit. ix. pl. 579.
2 Duhamel du Monceau, arb. fruit, 1768, i. 325, fig. p. 334.
3 Man. du Jard. 1829, 444.
4 Sprengel. Hist. Rei Herb. i. 25.
5 Darwin, An. and Pl. ii. 208.
6 Rumph. Amb. v. p. 126, t. 60.
7 Polynesian Researches, i. 372.
8 U. S. Ex. Exp. iii. 333.
9 Mueller, Sel. Pl. 136.
10 Gard. in India.
11 Hort. Bengal. 18.
12 Trop. Agr. 457.

Forster[1] does not attempt to enumerate, but says the plantain varies almost *ad infinitum* like an apple. A few more quotations will suffice. Heuze[2] says the banana has produced fourteen varieties in Malabar, twenty-nine in Tahiti, fifteen in Tonga, sixteen in Malaysia and eighty in Batavia. On the Amazon, Castelnau[3] notes an enormous number of varieties, and Grant[4] mentions very distinct kinds in Central Africa.

This very abundance of varieties shows that the fruit must occasionally produce seed, and such instances are recorded. On the coast of Paria, near the Golfo Triste, Humboldt[5] says the banana is said to occasionally produce germinating seeds if the fruit be allowed to ripen on the stem. At Bordones, also, near Cumana, perfectly formed and matured seeds have been occasionally found in this fruit. Other examples of seeding are given as we proceed.

Musa ensete, Gmelin, is cultivated[6] in Abyssinia in large plantations for the inner portion of the stem and the young spike, which is used as a staple vegetable. Its fruit is dry and inedible, containing a few large stony seeds.[7] There are many instances given of other banana fruit containing seed. Burton[8], in Central Africa says the best bananas are grown by the Arabs at Unyamyembe, but poor specimens, coarse and insipid, stringy and full of seed; upon Lake Tanganyika there is a variety called *Mikono t'humbo*, or elephant's hands, very large, the skin brick-dust red, the pulp a dull yellow, with black seeds, and the flavor harsh, strong and drug-like. On the Coromandel Coast, Roxburgh[9] found both bananas and plantains under culture, and says the original wild *Musa* from which all the cultivated varieties of both plantain and banana proceed, bears numerous seeds. In the Himalayas, Hooker[10] notes two species of wild plantain, which ripen austere and small fruits which are full of seeds, and quite

1 Forster, Obs. 177.
2 Les. pl. alim. ii. 569.
3 Quoted by Herndon, Amazon, 181.
4 Speke's Nile, 583.
5 Views of Nature, 305.
6 Bruce, Voy. v., 50, t. 8 and 9.
7 Masters Treas of Bot. art. *Musa.*
8 Burton, Lake Region of Central Africa, 316.
9 Roxburgh, Coromandel Pl. iii. 74.
10 Hooker, Himalayan Journal, i. 143.

uneatable. At Manilla, Meyen[1] states that there is a variety of banana full of seeds. At Luzon, he says[2] there is a permanent variety, Platano de Pepita, propagated by shoots, and though it contains a great number of seeds, the pulpy substance of the fruit is exceedingly well flavored. In India, Cochin China and Java, this variety is also found, the fruit full of seeds, and therefore, less esteemed for eating. Finlayson[3] expressly mentions the cultivated *Musa* with perfect seeds, and on the island of Ubi he found a wild *Musa* with fruit full of seeds, and little edible pulp. At Batavia in 1790, Captain Cook[4] found the variety called Pissang Batu or Pissang Bidjie to be full of seed, but he adds that it had no excellence to recommend it to the taste, but the Malays use it as a remedy for the flux. At New Holland[5] he speaks of a variety of wild plaintain with seeds and well tasted, although on a previous page he says plantains are not found there. At another page he says these wild plantains were so full of stones as to be scarcely eatable.

Among the more definite mentions of seedy bananas, we may note *Musa glauca*, Roxb.,[6] native of Pegu, the fruit containing little else but seed, and scarcely fit for a monkey to eat. Royle[7] records *Musa Nepalensis* as apparently wild in Nepal, the fruit containing little else than the hard dry seeds. Loureiro[8] in Cochin China describes *Musa semenifera* in three varieties, one with seeds and scarcely any pulp, another with many seeds and a sweet pulp, the third which rarely seeds and the pulp very sweet. Roxburgh on the Coromandel Coast describes *Musa superba* as ripening seed, the fruit of no use, and *Musa troglodytarum* is described in Miller's Dictionary as having numerous seeds and inedible fruit. The same is said of its synonym *Musa uranoscopus* by Loureiro. On the contrary Mueller[9] says the edible fruits

1 Quoted by Darwin, An. and Pl. ii. 205, note.

2 Meyen, Outlines of the Geog. of Pl. London, 1846, p. 326.

3 Jour. of Voy. to Siam, 1826, p. 86.

4 Cook, Voy. i. 304.

5 Cook, Voy. i. 234, 235.

6 Roxburgh, Coromandel Pl. Plate 300.

7 Royle, Ill. of Bot. of the Himalayas, 355.

8 Loureiro, Cochin Ch. 644.

9 Mueller, Select Plants, under *Musa*, p. 136.

are small, reddish or orange colored, upright and edible, and by the context seedless; and at the Edinburgh Botanical Garden[1], *Musa superba* furnished a great quantity of high flavored, and from the context, seedless fruits.

Musa rubra, the *Vai* of Cook, and *Fahie* of Wilkes, grows both wild and cultivated at Tahiti. Wilkes[2] says it is destitute of seed, and praises the fruit very highly. Another authority[3] says there are five varieties, and still another[4] states that there are twenty sorts, found wild. Mueller l. c. seems to consider this species as synonymous with *Musa troglodytarum*.

The cultivated bananas and plantains have been assigned to quite a number of species, and furnish almost innumerable varieties, all of which are normally seedless, and all of which are described as more or less delicious for those kinds which are eaten raw.

BARBERRY. BERBERIS VULGARIS, L. (BERBERIDEÆ).

The fruit hangs in pendulous racemes, the berry a one-celled ovary containing from one to eight seeds. The culture is scarcely of sufficient importance to justify expectation of varieties, yet Duhamel[5] mentions the common red, the seedless, the purple, the white, the broad-leaved, the box-leaved, etc., and the black fruited of Tournefort, from the banks of the Euphrates, which, is said to be of a delicious flavor. The purple-leaved in ornamental gardening, is familiar to us all.

The first mention of a seedless barberry that we find is by Gerarde[6], in 1597. The second edition of his works in 1636, also speaks of it in the same words. "We have likewise another without any stone; the fruit is like the rest of the barberries, both in substance and taste." In 1601, Clusius[7] had seen this kind at a village near Frankfort, and he pronounces it by far the best sort for preserves. It is mentioned by name by Bauhin[8], in

1 Bot. Mag. quoted Gard. Chron. 1841, Mar. 20. p. 182.
2 U. S. Exp. Exp. ii. 28, iii. 333.
3 Voy. of the Novara, iii. 243.
4 Ellis, Polynesian Researches, i. 372.
5 Duhamel du Monceau, arb. fruit, 1768, i. 151.
6 Herbal. 1579, p. 1144; 1636, p. 1325.
7 Clus. rar. plant, 1601, i. 121.
8 Bauhin, pin. 1623, p. 454.

1623, and shortly by Parkinson,[1] in 1629 and 1640, who evidently had never seen it, and also is recorded by Coles,[2] in 1657, by name, by Jonston[3] in 1662 by name, by Ray,[4] in 1688, Tournefort,[5] in 1719, and Miller,[6] in 1731. In 1750, an anonymous French work on gardening[7] describes it as being the most desirable sort, and Duhamel,[8] in 1755, says it is subject to occasional seeding; in 1768 he[9] says it is the variety most deserving of culture. Mawe,[10] in 1778, just mentions it by name, and it is noted by Willdenow,[11] in 1799, by Poiret,[12] in 1808, Noisette,[13] in 1829, and is described apparently from Duhamel by Downing[14] in recent times. I have found occasionally seedless fruits on hedge plants in Maine.

It would seem that this stoneless fruit has been unknown in England and America, or at least not recorded, but has been grown in Germany, and we find it stated by several authors that it is especially valued about Rouen, in France, for the making of preserves.

BEECH NUTS. FAGUS FERRUGINEA, AIT. (CUPULIFERÆ).

The beech nut is usually abortive in South Framingham, Massachusetts, while the empty shells are in some seasons abundant, yet I have never seen there perfect seed. In other localities, the nuts usually appear plump and well filled.

BREADFRUIT. ARTOCARPUS INCISA, L. (URTICACEÆ).

The edible portion is formed by the cohesion into a single mass of the floral envelopes and ovaria of a large number of

---

1 Parkinson, parad. 1629, p. 561, theat. 1640, p. 1559.
2 Coles, Adam in Eden, 1657, p. 273,
3 Jonston, dendrog. 1662, p. 220.
4 Ray, Hist. 1688, ii. p. 1605.
5 Tournefort, Inst. 1719, p. 614.
6 Miller's Dict. 1731, under *Berberis*.
7 Les agremens de la Campagne, 1750, 159.
8 Duhamel du Monceau, Traite, 1755, i. p. 98.
9 Duhamel du Monceau, arb. fruit, 1768, ii. 151.
10 Mawe., Gard. 1778, under *Berberis*.
11 Willdenow, sp. pl. 1799, ii. p. 228.
12 Poiret, Enc. Meth. Bot. viii. p. 616.
13 Noisette, Man. du Jard. 1829, p. 448.
14 Downing, Fruits, 1866, p. 244.

flowers, arranged on a central fleshy column or spike. Rumphins[1] reports the tree wild in Banda. At Tahiti[2] they reckon no less than thirty varieties. In the Samoan group, Wilkes[3] says there are twenty varieties, and in the Feejee Islands nine different kinds distinguished by fruit of different sizes and shapes, and the figure of the leaves. Peschal[4] says that twenty-seven trees, which would about cover an English acre with their shade, are sufficient for the support, during the eight months of fruit-bearing of from ten to twelve people.

The earliest record of the breadfruit is by the writer of the account of Mendana's[5] voyage to the Marquesas Islands in 1595. It was again noted by Dampier,[6] in 1688, who in his description says there is neither seed nor stone in the inside. Seeding forms are, however, described by Sonnerat,[7] and by Rumphius,[8] the latter figuring the *Soccus granosus*, which contains seed, and the *Soccus lanosus*, whose cavity contained no seed except in one variety which contained a few seed. Forster,[9] 1786, makes two varieties, one seedless, the other seed bearing. Of the first, he notes five different kinds, and of the second he remarks that on account of the superiority of the seedless kind, it has become neglected. Thunberg,[10] in 1779, says the fruit, the size of a child's head, sometimes has abortive seeds and sometimes none. Meyen[11] says the fruit generally contains seeds, and that by culture a number of seedless varieties have been formed. The seeds are said by Wilkes[12] to be often abortive in Tahiti. This tree came to Jamaica in February, 1793, and in 1814, Lunan[13] says that the varieties in Jamaica, save one, are seedless, and this ex-

---

1 Rumph. amb. I, p. 113, pl. 33.
2 Enc. Brit. xviii. 280.
3 U. S. Ex. Exped. ii. 121 ; iii. 333.
4 Races of Man. 156.
5 Enc. Brit. xviii. 281.
6 Dampier, Voy. i. c. 10.
7 Sonnerat, Voy. 99, t. 57-60.
8 Rumphius, amb. i, 110, t. 32.
9 Forster, Pl. esc. 1786, p. 23, See also obs. p. 179.
10 Thunberg, Phil. Trans. 1779, vol.. 69, p. 465.
11 Meyen, Outlines of Geog. of Pl. 1846, pp. 322, 323.
12 U. S. Ex. Exped. ii. 50.
13 Lunan. Hort. Jam. 1814, i. 113.

ception has but a small number, and is not good unless baked. He says in Otaheite they reckon eight varieties without seed, and one with seed, but it is inferior to the others. Wallace[2] says that the seeds are entirely abortive by cultivation; he praises the taste and compares it to Yorkshire pudding; a friend said it was like mashed potatoes and milk. "It is generally about the size of a melon, a little fibrous towards the centre, but everywhere else quite smooth and puddingy, something in consistence between yeast dumplings and batter pudding. It is in no way as good as simply baked. With meat and gravy, it is a vegetable superior to any I know." The seed-bearing variety, he continues, is common all over the tropics, and though the seeds are very good eating, resembling chestnuts, the fruit is quite worthless as a vegetable.

CABBAGE. BRASSICA OLERACEA, L. (CRUCIFERÆ).

Although not a fruit, yet it is interesting to note the relation of the seed to the recognized quality. Thus arranging the races in the order of delicacy, we have the following table:

	No. of Var. or Trials.	*Wt. of* 100 *Seed in grains.*
Cauliflower,	24	4.55
Broccoli	4	5.03
Brussels Sprouts,	2	4.06
Cabbage, Savoy	8	5.08
" White	38	5.62
" Red	4	6.17

CHAMÆROPS STAURACANTHA. (PALMÆ).

This tree has the character of producing sterile fruit, but mixed with fertile on the same panicle. The pulp of the fruit is of a peculiar delicate, spongy consistence and of a pure white and shining on the outside. The fruit is oblong, about one inch in longest diameter. It has probably, says Prestoe,[1] been brought under a certain amount of cultivation from very remote times.

2 Wallace, Malay Archipelago, p. 310.

1 Prestoe, Rept. Trinidad Bot. Gard. 1880, p. 39.

Cherry. Cerasus vulgaris, Mill. (Rosaceæ).

The cherry fruit is formed by a change in the substance of the carpellary leaf. The internal surface of this becomes hardened into the stone or endocarp, whilst the external surface or epicarp remains as a thin cuticle or skin, and the pulp or mesocarp is formed by the increase of the parenchyma or fleshy tissue of the leaf. There is much confusion in the cultivated species. The *griottes* of the French belong to *Cerasus caproniana*, DC.; the *bigarreaus* to *C. duracina*, DC.; the *Merisiers* or wild, to *C. avium*, DC.; the *guigniers* or *geans*, to *C. Juliana*, DC. Don[1] gives eleven sorts referred to *C. avium*, sixty-one to *C. duracina*, and thirty-eight to *C. Juliana.* In all, he names two hundred and twenty sorts. The London Horticultural Society in 1832 recognized two hundred and nineteen varieties. In 1866 Downing describes one hundred and thirty-two sorts, and in 1887, the American Pomological Society approves of forty-one kinds as deserving of culture. In the first century Pliny[2] speaks of the Apronianan as the reddest variety, the Lutatian as the blackest, the Cœcilian as perfectly round, the Junianian as agreeable, but very delicate and not bearing transportation, the Plinianan as the finest, the Lusitanian and those of the Rhine, besides several of doubtful interpretation. The Rhine cherry, he says, has a third color, being a mixture of black, red and green, and has the appearance of being just on the turn to ripening.

In the Geoponics,[3] directions are given by Democritus for raising grapes without kernels, and he says the same method will produce seedless cherries. Martial, as quoted by Palladius[4], avers the same. I find, however, very little on seedless cherries in later writers. Knight[5] says he crossed the Morello and Common Cherry, and obtained five cherries from nearly as many thousand blossoms, and four of these did not contain seed. In the best varieties of the cherry, I have found many of the kernels to be abortive. thus:[6]

1 Gard. Dict. Vol. 2, p. 505.
2 Pliny, lib. xv. c. 30.
3 Geop. lib. 4, c. 7.
4 Pall. lib. 3. c. 29; lib. 11, c. 12.
5 Phys. and Hort. Papers, 277.
6 Rep. N. Y. Ag. Exp. Sta. 1882, p. 81.

Variety.	*Total Pits Examined.*	*Per Cent. Abortive.*
Black Tartarean	30	37
Elton	20	15
Governor Wood	30	50
Black Eagle	3	17
Burr's Seedling	30	93

In October, 1884, I had planted quite a large number of cherry pits. July 24, 1885, the following numbers were found vegetated :

Variety.		
Black Tartarean	3	per cent.
Elton	0	"
Black Eagle	22	"
Buttner's Yellow	19	"
Napolean Bigarreau	13	"
Yellow Spanish	4	"
Average	10	

This limited data, supplemented by a large mass of unrecorded observation, leads me to believe that our improved varieties of the cherry are subject to partial sterility, which seems to be corelated with quality.

CITRON. CITRUS MEDICA, L. (RUTACEÆ).

This is a large oblong or ovate fruit, the skin rough with protuberances, and of the well known citron color when ripe. There are very many varieties, some round, some oval, others oblate spherical, and others fingered. Very many fingered forms are figured by the early writers. It is a pulpy fruit with a spongy rind. It is supposed by many botanists that the citron, the orange, the lemon, and the lime, are all derived from this species[1]. Brandis and Sir Joseph Hooker distinguished four cultivated varieties: *Citrus medica*, the Cedratier of the French, the Citron of the English, the Cedro of the Italians, called *Vijapura* in Sanscrit; *Citrus medica Limonum*, the Citrionnier of the French, the Lemon of the English; *Citrus medica acida* (*C. acida*, Roxb.), called in Sanscrit *Jambira ; Citrus medica Limetta* (*C. Limetta* and *C. Lumia*, Risso), the Sweet Lime.[2]

The Chinese citron, the cedrat of Florence, and several others

1 Lindley, Jour. of Hort. Soc., x. 171.

2 DeCandolle, L'Orig. des. pl. cult. 1883, 142.

which resemble them, are sterile or nearly so; the Ponciere is always seedless; the large orange citron has a thin and acid pulp, and never contains seed.[1] The Troon or Tabernacle citron is so highly prized at Mogador by the faithful observers of Israelite traditions, that specimens without blemish are sold at a very high price. It is rather larger than a lemon, and is said to contain only one pip, to be of a very fine nature, and to keep sound for a very long period.[2]

CUCUMBER. CUCUMIS SATIVUS, L. (CUCURBITACEÆ).

This fruit consists of three carpels united together and forming one cell, but having the ovules arranged on three lines which pass up the sides. It has been planted in gardens from most ancient times, and often appears as an escape in suitable climates, and has been described under a number of specific names[3]. There are many varieties. Ibn-al-awam describes five in Spain in the twelfth century. Parkinson in England, in 1629, describes six; L'Horticulteur Francais, 1824, names seven kinds; Noisette, in 1829, names or describes ten sorts; the New York Agricultural Experiment Station Report for 1887 describes twenty-six varieties under one hundred and thirty-two synonyms.

In the Geoponics, lib. xii. c. 19, directions are given how to raise cucumbers without seed, so also by Palladius, and seedless cucumbers are mentioned by Ibn-al-awam, a Moorish-Spaniard of the twelfth century. Loudon[4] says many persons prefer cucumbers which have not been fecundated, on account of the much smaller size of the seed integuments, which never contain kernels. These seedless cucumbers of the English Frame varieties frequently appear under forced culture in our greenhouses, and also when grown in the open air. In 1882 an advertisement of Sharpe's Epicurian Cucumber in the "Gardener's Chronicle," says it is "a variety that seldom produces seeds, not one in a hundred containing a trace." Large cucumbers of fine quality are usually little seedy. At the New York Agricultural Experiment Station in 1885, the following varieties contained but few seed as compared with the rest,

1 Gallesio, Citrus Family, Fla. Agr. Trans. p. 16.
2 Gard. Chron. Nov. 8, 1884, p. 601.
3 Cogniaux in DC., Monog. iii. 499.
4 Loudon, Hort. 1860, p. 495.

viz.: Vert long de Chine; Turkey Long Green; Peerless White Spine; Perfect Pickling; Large White Bonneville; and Carter's Best of All. In 1882 the English Frame Cucumber, Giant of Armstadt, was the finest flavored of all varieties tested, but contained no fertile seed.[1] In the glass culture for our markets seedless cucumbers are frequently found, and as under the conditions that seedless fruits occur the vines set badly, it is often the custom for the growers to place a hive of bees within the glass-house so that these insects may further the act of fertilization.

CURRANT. RIBES RUBRUM, L. (SAXIFRAGEÆ).

The berries are one-celled, and contain numerous seeds suspended in pulp by long threads. Thory[2] recognizes eight botanical varieties, the large-berried, the rosy-fruited, the white, the pearl, the variegated leaved, the white-nerved, the flowers in spikes, and the reddish. Duhamel[3], in 1768, describes the large red, the flesh-colored, the white and the pearl. Forsyth[4], in 1803, recognizes seven varieties; Thomas[5], in 1867, describes eighteen sorts, and Fuller[6] twenty-six.

The number of seed to the berry varies considerably in the currant. In some countings[7] the Cherry variety averaged 14.1 seed to a berry, but some extra large berries averaged 15.2 seed and one large bunch gave fruit with twenty seed. Some Red Dutch berries averaged 4.8 seed, and some White Dutch 9.8 seed. In some unreported observations, seedling plants were grown from seed taken from berries with few and many seeds. The plants from the very seedful fruits were larger, coarser and hardier than those grown from the few-seeding. The best fruit was found in the few-seeded, but not equal to the fruit of named varieties. The trial as regards corelation between seedlessness and quality was indecisive, yet full of suggestion. In the case of

---

1 Rept. N. Y. Ag. Ex. Sta. 1882, p. 126.
2 Monog. du genre Groseillier, 1829, p. 9.
3 Duhamel du Monceau, arb. fruit, 1768, i. 266.
4 Fruit Trees, Albany, 1803, p. 113.
5 Americam Fruit Culturist, 1867, 427.
6 Small Fruit Culturist, 1867, 203.
7 N. Y. Ag. Ex. Sta. Rept. 1882, p. 80.

the currant we have the largest berries containing the most seed, as is the case with the grape. In the same bunch berries may be found containing three to eighteen seeds.

Cycads.

In Focke's work—Die Pflanzen Mischlinge—he states that female plants of Cycads often produce apparently perfect cones in greenhouses in Europe, yet their seed contains no embryo[1].

Date. Phœnix dactylifera, L. (Palmæ).

In the date the epicarp is the outer brownish skin, the pulpy matter is the mesocarp, and the paper-like lining is the endocarp covering the hard seed. This seed is composed of horny albumen with a groove down the front and the embryo placed at the back. The two sexes are borne on distinct trees, and the female tree is usually fertilized artificially. In India, Arabia, and elsewhere, this is done before the flower-spathes open, by boring a hole in the sheath of the female flowers and inserting therein a few bits of the male panicle[2]. Theophrastus was acquainted with this method, and Pliny also had knowledge of the necessity.

The fruit of the wild date consists more of seed than of pulp, and altogether is only about one-fourth the size of the Arabian kind brought annually to Calcutta for sale[3]. On the oasis of Sirvah, four kinds were seen by St. John[4], the Sultana, a long blue one; Farayah, white and said not to grow in Egypt; the Saidi, a common date; the Weddee, good only for camels and donkeys; also a very luscious yellow sort. Dr. James Richardson found no less than forty-six sorts cultivated in the oases of Northern Africa[5]. Those of Gomara, says Mueller[6], are large and contain no seed. Seedless dates are mentioned by Theophrastus[7], the third century before Christ, and by Pliny[8] in the

1 Gard. Chron. Apr. 14, 1883, p. 466.

2 Stocks, Hooker's Journ. of Bot. vii. 551.

3 S. N. Robinson, Jour. Agric.-Hort. Soc., ix. quoted by Firminger, Gard. in Ind. p. 172.

4 Adventures in the Libyan Desert, p. 188.

5 Archer, Profit. plants, p. 31.

6 Mueller, Sel. Pl. p, 162.

7 Theop. De plant. Bodaeus a Stapel ed. 1644, 90, 102.

8 Pliny, lib. xiii, c. 7.

first century, who says small fruit without seed are often found on the same shoots with others. At Maesaba, in Palestine, there is a date palm in a convent courtyard, said to have been planted by St. Saba, A.D., 490, which always bears stoneless fruit[1], and at Mooltan, India, there is one tree which bears a stoneless fruit, and in former years it was considered a royal tree and the fruit was reserved for the reigning sovereign[2].

DIOSCOREA ACULEATA, L. (DIOSCOREACEÆ).

The fruit of this yam, eaten by the common people of Malabar, according to Rheede,[3] has no seed.

DIOSPYROS MELANOXYLON, ROXB. (EBENACEÆ).

This species has an ovoid or globose yellow fruit, about an inch to an inch and a half in diameter, with yellow pulp, soft, sweet and slightly astringent. The seeds four to eight[4]. In India, Forsyth[5] mentions a cultivated variety without stones.

DIOSPYROS SCHI'TSE, BUNGE. (EBENACEÆ).

This large orange-colored fruit of northern China, as sold in the streets of Peking, according to Bretschneider,[6] is always aspermous.

FIG. FICUS CARICA, L. (URTICACEÆ).

This is an anthocarpous fruit, in which the axis or the extremity of the peduncle, is hollowed, so as to bear within numerous flowers, all of which are united in one mass to form the fruit. Dr. Presl[7] enumerates no less than forty varieties that are cultivated in Sicily. Dr. Robert Hogg[8] enumerates sixty-five. In the United States a leading firm of nurserymen[9] offer twenty-five varieties in its list. The London Horticultural Society's Catalogue[10] give forty-two varieties.

---

1 Gard. Chron. Jan. 23, 1886, p. 114.
2 Journ. Agri.-Hort. Soc. of Ind., 1867, Nov. 20.
3 Rheede, Malabar, vol. vii., p. 71.
4 Brandis, Forest Flora, p 294.
5 Highlands of Central India, p. 463.
6 Bretschn. Bot. Sin. 111.
7 Hooker's Journ. of Bot. i. 142.
8 Fruit Manual, 3d ed. p. 102.
9 Ellwanger & Barry, Desc. Cat. 1880.
10 Downing, Fruit, 1866, p. 290.

The flowers of the wild fig are used for the caprification of the cultivated fig in various parts of the East. This process was known to the ancients[1].

The cultivated fig bears two sorts of fruit; in the spring early figs or *fiorones*, and in the summer late figs. In the *fiorones* male flowers are very rarely found, and the few that may be present cannot serve for fecundation, for they do not appear until long after the stigmata of the female flowers are dried and destroyed. "I have never been able," says Prof. Gasparrini[2] "to find seeds with embryos in the *fiorones*." The summer fruit, on the contrary, have no male flowers, and yet nearly all of their ovaries become perfect, that is, furnished with embryos. Many kinds of figs, says Brandis[3], have sterile seed, that is, seed in which the embryo has not been developed, and therefore, fecundation is not an essential condition to the ripening of figs.

GOURD. LAGENARIA VULGARIS, SER. (CUCURBITACÆ).

Directions for making the gourd seedless are given in the Geoponics, lib. xii. c. 19, and Ibn-al-awam, in the twelfth century, a Moorish-Spaniard, mentions seedless gourds. Since the appearance of the pumpkin and squash, at the discovery of America, the gourd has scarcely been grown in Europe for edible purposes, and hence has been but little under observation.

GRAPE. VITIS SP. (VITACEÆ).

The grape is botanically a berry, an indehiscent fruit which is fleshy or pulpy throughout. The seeds nestle in pulp formed from the placentas. The berry is formed from the ovaries alone. All the true grape vines bear fertile flowers on one stock, and sterile flowers on another separate stock, and are, therefore, called polygamous, or not quite correctly, diœcious. The sterile plants bear male flowers with abortive pistils, so that while they never produce fruit themselves, they may assist in fertilizing the others; the fertile flowers, however, are hermaphrodites, con-

1 Diosc. lib. 1. c. 184; Theoph. lib. 1. c. 8; Arist. U. An. lib. v. c. 26. See also Walpole's Turkey, xxiii. 241, note. Pliny, lib, xv. c. 19 and lib. xvii. c. 27.

2 Ann. des Sc. (III). t. 5, p. 306.

3 Forest Flora, p. 419.

taining both organs—stamens and pistils—and are capable of ripening fruit without the assistance of the male plant[1].

Grape. Vitis Labrusca, L.

In 1884 I saw bunches of the Wyoming grape which carried many seedless berries; the seedless grapes were small and ripe, with scarcely any toughness to the pulp, while the seeded berries were of the usual size and unripe. Professor Bailey[2] records an analagous example with a hybrid form. The larger part of the bunch bore fruit of the ordinary size, and the ordinary almost insipid flavor, but one bunch bore fruit about half as large, with thinner skin, an entirely different and better flavor and seedless.

On account of the uncertainty attending the classification of our cultivated varieties, I offer such notes as I possess under this heading. I am indebted to Professor E. S. Goff, of Madison, Wis., for assistance in this counting.

Variety.	*No. of Berries.*	*No. of Seed.*	*Av Seed per Berry.*
Vitis Labrusca, (Wild.)	521	1406	2.69
Vitis cordifolia, (Wild.)	75	191	2.54
Brighton, (Labrusca)	91	146	1.60
Catawba, (Labrusca)	385	825	2.14
Clinton, (Riparia)	184	280	1.52
Concord, (Labrusca)	719	1323	1.84
Delaware, (Lab. × Vinif. ?)	1311	1722	1.31
Iona, (Labrusca)	20	45	2.25
Isabella, (Labrusca)	55	88	1.60
Salem, (Lab. × Vinif.)	151	355	2.35
Vergennes, (Labrusca)	111	186	1.67

In a number of countings I have the material for arranging in another form: thus—

	No. of Berries.	*No. of Berries With*						
		0 Pips.	1 Pip.	2 Pips.	3 Pips.	4 Pips.	5 Pips.	6 Pips.
Vitis, Labrusca	521	0	84	138	172	112	8	7
Vitis cordifolia	75	0	13	25	20	17	0	0
Brighton,	91	2	46	31	10	2	0	0
Catawba,	355	0	85	158	99	13	0	0
Clinton,	184	0	89	89	6	0	0	0
Concord,	719	1	263	323	117	15	0	0
Delaware,	1311	5	934	329	42	1	0	0
Isabella,	25	0	14	10	1	0	0	0
Salem,	151	0	27	62	44	18	0	0
Vergennes,	111	3	49	41	17	1	0	0

1 Engelmann, Bushberg Cat., 1883, p. 9.

2 Bull. No. 31, Mich. Ag. Coll. 1887, 85.

In the case of these grapes, the largest berries have the most seed.

GRAPE. VITIS VINIFERA, L.

The Geoponics[1], as also Columella[2], gives directions for obtaining grapes without kernels, and Palladius[3] mentions a beautiful sort without stones, and Pliny[4] mentions the Rhætica, as possessing the thinnest skin of all the grapes and but a single stone. The description does not further suggest the Muscat of Alexandria grape, but specimens of raisins from these made in California, I found, in 1881, to contain but a single seed, with one other abortive remnant of a seed. In 1503-8, Ludovico de Varthema[5] found at Reame, a city of Arabia Felix, a white grape, which had no seeds within, than which, he says, I never tasted better. Parkinson[6], in 1629, says "the grape without stones is also a kind of it selfe, and groweth naturally neere Ascalon, as Brochard affirmeth, the wine whereof is redde, and of good taste."

The word "raysons of corannte" occurs in "The Forme of Cury" an English cook book compiled about A. D. 1390[7], and is the first reference I find to the Corinth grape. Dalechamp[8], in 1586, speaks of the *apurenoi*, that is, seedless, which are commonly called Corinth, and grow in the gardens of Italy and Piedmont. Modern authors describe the white and purple varieties of the Corinth grape as seedless, and this grape furnishes the "dried currants" of our kitchens. In California I am told that the Zante or Corinth grape so frequently seeds as to check the attempt to prepare this article of commerce, and that in Australia the same thing happens[9]. It would appear that this grape has been transmitted through cuttings for unknown centuries.

Among the grapes of Cabul is the "ungoor-i-Kishmishee" a fruit not large, round, transparent, seedless, sweet and luscious.

---

1 Geopon. lib. 4, c. 7.
2 Col. de arb. c. 9.
3 Pal. de re rust, Feb. c. 29.
4 Pliny, lib. xiv. c. 4.
5 Travels of. Hakl. Soc. ed. p. 77.
6 Parad. 1629, p. 564.
7 Warner, Antiq. Culin. 1791. The Forme of Cury, Receipt, 14, etc.
8 Dalechamp, hist. gen. 1586, p. 1406.
9 E. J. Wickson, San Francisco, Cal., in letter of Feb. 13, 1880.

In Bulkh, the sweetest and best wine grape is called Kishmish; it is black, oval, of good size and seedless[1]. The white wine of Ispahan is made from a white grape called Kishmish, which has no pips[2]. Niebuhr[3] says the Arabians dry a small sort of grape called Kischmish which has no stone, but only soft and almost impalpable seeds. Pallas[4] says in Astracan, the Kyshmish or the grape without stones ranks first and is esteemed the best kind.

The Sultana grape in California is seedless, as Mr. Wickson informs me, and in the graperies of the Department of Agriculture at Washington, Mr. Saunders tells me it is also seedless. Arnold[5] speaks of the small stoneless grapes in Persia, which when dried, are sold as "Sultana" raisins, and praises their quality. The grapes of Eschol[6] have generally a transparent membranous seed, though some are said to have no seed at all, and Le Bruyn describes similar grapes without seed in Persia. In the Punjaub they have an indigenous stoneless grape called the Bedana[7].

The grapery of the late M. H. Simpson, of Saxonville, Mass., contains a seedless Black Hamburg vine, of which I have frequently eaten the fruit. The quality is exceptionally fine, but the berry is small. The brittle nature of the seed of our greenhouse grapes is familiar to all.

In counting the seeds of the *Vinifera* class of grapes, I have found:

Variety.	*No. of Berries Examined.*	*No. of Berries with* 0 Pips.	1 Pip.	2 Pips.	3 Pips.	4 Pips.	5 Pips.	6 Pips.	*Seeds to a Berry.*
Black Hamburg,	102	3	27	31	32	9	0	0	2.18
Morocco (Calif,)	126	3	83	32	5	3	0	0	1.38
Tokay, (Calif.)	268	13	83	100	46	21	4	1	1.97

GUAVA. PSIDIUM GUAYAVA, RADDI. (MYRTACEÆ).

In this fruit the seeds nestle in pulp formed by the placentas. The savory fruit, of the size of an apple, is highly relished in

1 J. Harlan. U. S. Pat. Off. Rept. 1861, 529, 534.

2 Redding quoted, U. S. Pat. Off. Rept. 1860, 367.

3 Travels through Arabia.

4 Travels, i. 313.

5 Arnold, Through Persia by Caravan, 151.

6 Calmet, Dict. of the Bible.

7 Firminger, Gard. in Ind. 212

many localities, and is eaten raw or made into a conserve. It is covered with a rind of some thickness, within which are the seeds contained in the pulp, without any shell. The contained pulp is of white, red or yellow color in the varieties, full of bony seeds, as Lunan remarks[1]. Its cultivation has been carried on by the primitive inhabitants of the main land of America from Mexico to Brazil, from time immemorial, says Unger[2], and it is frequently without seed.

KAKI, OR JAPANESE PERSIMMON. DIOSPYROS KAKI. (EBENACEÆ).

In California Mr. E. J. Wickson[3] writes that some Japan persimmons bear seedless fruit the first year, but the second year seeds appear. In a southern paper[4] the Zingi variety is stated to have buttery melting sweet flesh, and to be without trace of seed. C. C. Georgeson[5], in 1887, figures and describes twelve sorts in Japan, one sort with seed is described as "best"; one with the fact of seedlessness or otherwise, or quality not noted; two with seed not noted, but quality best; one, seed not noted, quality very good; three seedless, quality *best*; three seedless and quality delicious; one seedless, quality very good. J. B. Berckmans[6] figures and describes eleven varieties; of these one with seed is pronounced excellent; of two he gives no particulars; one, no statement regarding seed, but quality very sweet, and another with no mention of seed, quality good; of the seedless, one has no statement of quality, one is pronounced good, two are very sweet, one is excellent, and one is *best*. Mr. N. E. Vandeman[7] seems to be able to separate but three varieties in this country as sufficiently well recognized out of the confusion of very many names. Of these the Hachiya has numerous seeds, the quality below that of some varieties; the Tane-nashi is seedless, and one of the choicest sorts; the Yemon is seedless, and the best in

1 Hort. Jam. i. 350.
2 U. S. Pat. Off. Rept. 1859, 349.
3 Letter dated Feb. 13, 1880.
4 Southern Enterprise, Dec. 1880, p. 72.
5 Orchard and Garden, Oct. 1887, Figures.
6 Rural New Yorker, Oct. 8, 1887.
7 U. S. Dept. Ag. Rept. 1887, p. 643.

quality. In Japan there are recognized some fifty varieties, thirteen of which Henry Loomis[1] pronounces as constituting the leading sort. Of these the Yemon has some specimens seedless, especially when the trees are young. The quality seems to be excellent, superior to many, but not equal to the Gosho.

Laurel Cherry. Prunus laurocerasus, L. (Rosaceæ).

Bauhin in his Pinax, 1623, speaks of the *Cerasus folio laurino* as commonly having a stone fruit, but that at Trebizond there is a stoneless form. This species, a native of Trebizond, is said by Baillon[2] to have been introduced to Europe in 1576, and is abundantly cultivated in England and France. Its leaves are used for aromatic flavoring in cookery.

Lemon. Citrus medica, var. Limonum, L. (Rutaceæ).

The common lemon, says Gallesio[3], contains many seeds. It produces hybrids and varieties that have few seeds, and sometimes no seeds, and it is always in those deviating most from the types that we remark this sterility. The double flowered lemon is a tree whose flowers have many petals, but are not entirely sterile. It has no seeds. In California, Carey's Eureka variety bears fruit nearly seedless, the rind thin and sweet, the pulp very juicy[4]. In South Africa, Thunberg[5] writes that he met with a lemon which contained another within it, furnished with a red rind, and that neither of these two lemons had any seed.

Lime. Citrus Limetta, Risso. (Rutaceæ).

The lime of Naples, the fruit the smallest of European lemons, has a smooth, thin, odorous rind. Its pulp is abundant, its juice acid and agreeable because of its delicacy and aroma. It has no seeds, and as Gallesio[6] states, is one of the most highly esteemed lemons.

---

1 Scientific Farmer 1879, p. 78.

2 Baillon, Hist. of Plants, i. 441.

3 Treatise on the Citrus Family. Florida Ag. Trans. pp. 16, 23.

4 Carey, Lecture on Orange and Lemon Culture, p. 14.

5 Travels, ii. 141.

6 Gallesio, Treatise on the Citrus Family, p. 24.

LOTOS. ZIZYPHUS LOTUS, DESF. (RHAMNEÆ).

Theophrastus[1] says the lotos without stones is the best. Pliny[2] says that the fruit which has no stone in the inside is the best. Decandolle identifies this lotos with *Zizyphus lotos*, Desfont. This fruit is of the size of sloes, containing large stones[3], and is an important article of food in Tunis and Barbary. The Arabs are excessively fond of it, and Park in Africa describes the small farinaceous berries as of a delicious taste. Consult Sprengels Hist. Rei Herb. p. 22, 83 and 251.

LUCUMA BIFERA, MOL. (SAPOTACEÆ).

This Chilian tree, according to Molina[4], bears fruit twice a year. The one set early in summer, have no kernels; the other set in autumn have two kernels. It is cultivated.

MALAY APPLE. EUGENIA MALACCENSIS, L. (MYRTACEÆ).

This tree is cultivated in the Indian Archipelago, the Pacific Islands, China, India, etc[5]. Firminger says the fruit is of the size and form of a very small apple, perfectly smooth, of a pure translucent white with a crimson blush, that some persons eat it, but that it is not worth the eating. Cook[6] says the fruits at Batavia are pleasant and cooling, but not possessing much flavor. Seemann describes the flavor as delicate: Lindley says when well ripened, delicious. Louriero commends it in Cochin China. There are apple-shaped, quince-shaped and pear-shaped varieties mentioned. Bauhin in his Pinax, 1623, mentions a stoneless variety.

MANGO. MANGIFERA INDICA, L. (ANACARDIACEÆ).

Of this fruit there are numberless varieties, differing in color, form and savor as do the pears and apples of Europe, says Loureiro. In some of its varieties it is esteemed delicious. About

---

1 Theop. Hist. pl. lib. iv. c. 4.

2 Pliny, lib. xiii. c. 32.

3 Don. Gard. Dict.

4 Molina, Hist. nat. du Chili, Paris, 1789, p. 169.

5 Firminger, Gard. in India, 265.

6 Cook, Voy. i. 305.

A. D., 1300, Friar Jordanus[1] says it "is a fruit so sweet and delicious as it is impossible to utter in words." Acosta[2] says that a stoneless variety is found, which is especially grateful to the palate. Garcia ab Horto[3] somewhat earlier records a variety called *Guzarateus* on account of its excellence, somewhat smaller than the common sorts, yet superior in savor and odor, and having a very small nut or stone. Rumphius[4], in 1741, describes the best variety in Amboinia as having a small stone. The mango differs greatly in its varieties, and while some receive the highest encomium, others resemble in taste, as is commonly said, a mixture of tow and turpentine. In India it seems to occupy the place that apples do with us.

MANGOSTEEN. GARCINIA MANGOSTANA, L. (CLUSIACEÆ).

The first mangosteen which ripened in England was of the size of a St. Michaels orange. It was of a deep plum color, and upon being opened was found perfect in every respect except the formation of seeds, of which there was no trace. Its quality was delicious[5]. F. W. Burbridge[6] says that in its wild state the interior of the fruit consists of four divisions only, all four containing each a perfect seed, whereas in the much larger cultivated fruits there are seven or eight divisions, and of these rarely more than one contains a perfect seed. Rumphius[7] says that some segments in the cultivated fruit are often seedless, and that frequently some fruit contain no fertile seed.

This fruit is deemed by many the most delicious fruit of the world. Bayard Taylor thus describes it: "Beautiful to sight, smell and taste, it hangs among its glossy leaves, the prince of fruits. Cut through the shaded green and purple of the rind, and lift the upper half of it as if it were the cover of a dish, and the pulp of half-transparent, creamy whiteness stands in segments like an orange, but rimmed with darkest crimson where the rind

---

1 Marvels described by Friar Jordanus. Hakl. Soc. ed. p. 14.
2 Acosta. Aromaticum, 1582, p. 70.
3 Aromatum, 1567, 217.
4 Amb. 1741, i. 94.
5 Gard. Chron. 1855, p. 259.
6 Gard. Chron., Jan. 5, 1884, p. 23.
7 Amb. i. 132.

was cut. It looks too beautiful to eat; but how the rarest sweetest essence of the tropics seem to dwell in it as it melts to your delighted taste."

MEDLAR. MESPILUS GERMANICA, L. (ROSACEÆ).

Duhamel[1] describes and figures a medlar without seeds, and says it is preferred as being more delicate and of a softer texture than the common kind. Noisette[2] speaks of it as a singular fruit, but small and of mediocre quality. Don[3] mentions the stoneless medlar as bearing a small fruit of little merit, and Loudon[4] gives the same description. In 1880 a French nursery catalogue advertises a variety of medlar under the name of "Stoneless."[5]

MELON. CUCUMIS MELO, L. (CUCURBITACEÆ).

Melons of the highest quality contain fewer seed than do varieties of medium or inferior quality, as I have often observed. This even seems to hold true as between individual fruits of the same variety to a marked extent. Cæsalpinus, in 1538, notes that melons with small seed are the best for eating. In four varieties selected for their high quality, the following particulars were obtained.

Variety.	*No. of Spec.*	*Av. No. of Seed.*	*Av. Wt. of Seed Grs.*	*Av. Wt. of Fruit Grs.*	*Per Cent. of Seed.*
Christiana,	3	512	234	18,621	1.25
Hackensack,	1	550	273	29,181	.93
New Surprise,	3	530	231	12,443	1.85
Shaw's Golden Superb,	1	494	203	12,632	1.60

MULBERRY. MORUS ALBA, L. AND VAR. NIGRA, L. (URTICACEÆ).

The edible portion of the mulberry is formed by the cohesion into a single mass, of the floral envelopes and ovaries of a large number of flowers arranged on a central fleshy column or spike, the calyces becoming succulent, and investing the pericarps. In

1 Duhamel du Monceau, arb. fruit. 1768, i. 331.
2 Noisette, Man. du Jard. 1829, 439.
3 Don. Gard. dict. 1832, ii. 605.
4 Loudon, Hort. 552.
5 Transon Bros. Orleans, France. Cat. of 1880-1.

Asiatic countries the fruit is held in esteem. In Kashmere and Afghanistan, says Brandis[1], there are varieties sweet and acid, of all shades of color from a white to a deep blackish purple. Downing[2] describes one cultivated variety of *M. rubra*, one of the *M. nigra*, and one the Everbearing, derived from *M. multicaulis*. The fruit of several other species are, however, valued in the Orient.

Forskal[3] notes about Constantinople the cultivated mulberry as having a succulent pulp and few seeds. Brandis[4] quotes Stocks that in Beloochistan there is a seedless variety called *Bedana*. Schuyler[5] says that in Turkistan the Khorasmi mulberry from Khiva, large white, almost seedless, is greatly used for food both when fresh and dried. Harlan[6] says that in the markets of Cabul, the white-seeded mulberry or Shah-toot, the thickness of the small finger, is very sweet, and in its season forms the chief food of the poor. It is a grafted fruit.

MYRTLE. MYRTUS COMMUNIS, L. (MYRTACEÆ).

The fruit of the myrtle is eaten by the modern as it was by the ancient Athenians[7]. It is, however, of little prominence in the cookery of even southern nations. Camerarius[8] speaks of a tree that produced fruit without seed.

OLIVE. OLEA EUROPŒA. (OLEACEÆ).

The recent prominence given to olive culture in California, has brought to view some facts concerning the corelations of seedlessness with quality. The following is taken from the bulletin of Feb. 15th, 1890, from the University of California Agricultural Experiment Station, (No. 85).

---

1 Forest Flora, 407.
2 Fruits, 1866, p. 347.
3 Forskal, fl. Aeg. Arab. 1775, p. xxxiii.
4 Brandis, Forest Flora, p. 408.
5 Schuyler, Turkistan, i. 196.
6 J. Harlan, U. S. Pat. Off. Rept. 1861, 529.
7 Hogg, Jour. of Bot. i. 117.
8 Camerarius, Hort. med. 1588, 95.

Dimensions in 16ths of an inch.

Variety of Olive.	*Whole fruit.*		*Pit.*		*Pit per cent.*
	Length.	*Width.*	*Length.*	*Width.*	*by bulk.*
Regalis,	17	13	9	5	7.8
Manzanillo No. 1,	16	13	9	5	8.3
Nevadillo Blanco,	16	10	10	4	10.0
Pendulina,	12	9	7	4	11.5
Columella,	14	11	8	5	11.8
Mission,	16	10	10	5	15.6
Polymorpha,	19	12	12	6	15.8
Rubra,	12	8	8	4	16.7
Rock's Oblonga,	15	8	11	4	18.3
Redding Picholine,	8	6	6	4	33.3
Uvaria,	13	9	10	6	34.2

ONION. ALLIUM CEPA, L. (LILIACEÆ).

The top-onion may be mentioned as a plant not bearing seeds, yet I have often observed a few seeds arising from among the bulbs. In one case an onion of the ordinary sort became injured in the stalk. From the split a cluster of bulbs protruded, and the "top" failed to produce seed.

OPUNTIA. (CACTEÆ).

Opuntia Davisii, Engelm., is common on the Upper Canadian, near the Llano Estacado, Tex. All the fruits observed were sterile, and most of them elongated, one to one and a quarter inches long, as Engelmann states[1]. In Sicily a variety of *Opuntia Ficus-indica* has fruits without seeds[2].

ORANGE. CITRUS AURANTIUM, L. (RUTACEÆ).

This fruit is botanically a hesperidium, or a berry with a leathery rind. It consists of the carpels surrounded by the external coat of the ovarium, and having the space between their inner wall and the seeds they contain filled with a very succulent

1 Engelmann, Pac. R. R. Report, iv. 49, Fig. pl. xvi.

2 P. L. S., Gard. Chron. Aug. 9, 1884, p. 171.

cellular tissue. The rind consists of epicarp and mesocarp, while the endocarp forms partitions in the interior filled with pulpy cells which are produced from the inner lining of the pericarp. There are many varieties In Sicily[1] fourteen kinds are recognized; Loudon[2] mentions nineteen; Downing[3] twelve; Gallesio describes forty of the principal kinds cultivated in Italy. The varieties named in Florida and California are very numerous, and some as the mandarin and tangerin have been described as species.

Gallesio asserts that in cross-breeding oranges, often monstrous fruits were produced, which included "little pulp, and had no seeds or imperfect seeds." Darwin,[4] in commenting upon this, states that a myrtle-leaved orange in his father's greenhouse, during many years rarely yielded any seed, but at last produced one; and the tree thus raised was identical with the parent form. D. J. Browne[5] speaks of the varieties of orange, some with a navel-like protuberance with no seeds. This appears to be the the Navel or Bahia variety, which in the State of California is perfectly seedless[6], as also in Florida, as I have myself observed. Mr. H. E. Vandeman[7] speaks of the variety as being almost entirely seedless. Another seedless orange in California is Garey's Mediterranean Sweet; it is of large size, excellent flavor, very delicate texture, and the larger number are entirely seedless[8]. A Japanese orange, the *Mushin Tane Nashi Mikaw* is said[9] to bear a seedless fruit on a thornless tree. The St. Michael orange is also of the seedless kind. Dr. Balfour[10] states that the thinness of the rind and its freedom from pips depend on the age of the tree. The young trees when in full vigor bear fruit with a thick

1 Hogg, Hooker's Jour. of Bot. i. 106.

2 Hort. p. 608.

3 Fruits, 1860, p. 691.

4 Darwin, An. and Pl., i. 405.

5 U. S. Pat. Of. Rept. 1858, 266.

6 E. J. Wickson, Ed. of Pac. Rural Press, in letter of Feb. 13, 1880.

7 U. S. Dept. Ag. Rept. 1887, 641.

8 Pacific Rural Press, Aug. 1877.

9 South Cal. Hort. Jour. 1878, p. 292.

10 Balfour's Botany, p. 280.

pulpy rind and abundance of seed, but as the vigor of the tree declines, the peel becomes thinner and the seeds gradually diminish in number till they disappear altogether. Browne[1] says the St. Michael orange, one of the most delicious of all varieties, is known by its small seedless fruit. Loudon[2] says this variety is generally without seed and Downing[3] says the pulp is often seedless, juicy and lusciously sweet.

Seedless oranges were known several centuries ago. Bauhin[4], in 1623, refers to the "*malus aurantia major * * * alia absque semine sunt*," and Ferrarius[5], in 1646, describes and figures a seedless orange as does also Aldrovandus in 1668. The Navel or Bahia, with synonyms Washington Navel and Riverside Navel, certainly ranks as the most delicious sort. In a wild orange grove near Matanzas Inlet, Florida, in 1869, I found one wild orange tree bearing fruit with a sweet pulp and bitter rind; this contained fewer seed than did the bitter oranges adjoining.

In counting the seed of some oranges in 1881 and 1882, the varieties were sorted according to quality before the counting was concluded. The following figures were obtained:

	No. of Spec.	*Av. No. Good Seed.*	*Av. No. Abortive Seed.*	*Wt. of Seed Grs.*
Florida Orange, tender	5	6.2	0.8	18.6
" tough	2	11.0	1.5	47.7
Valencia Orange, tender	15	8.8	1.6	29.8
" " tough	10	12.8	1.5	40.0
Messina Orange, good	1	4.	2.	19.

Otaheite Apple. Spondias dulcis, Forst. (Anacardiaceæ).

The Otaheite apple, says Forster[6], which contains a hard cap-

1 Trees of Am., 59.

2 Hort. p. 608.

3 Fruits, p. 694.

4 Bauhin, Pinax, 1623, 436.

5 Hesperides, 1646, lib. 4, c. 4, p. 383. Aldrovandus, Dend. 1668. 488.

6 Forster, obs. p. 179.

sule, commonly has no seeds in the locuments or divisions. Ellis[1], however, says it has a hard and spiked core, containing a number of seed. He calls it an excellent fruit. Forster in his De Plantis Esculentis says the seeds are solitary, ovate, compressed, usually abortive, thus recognizing both states of seeding and seedless. Firminger[2] says he is told that in India the stones never germinate, but young plants are usually obtained by grafting upon seedlings of *Spondias mangifera*, another species.

PEACH. AMYGDALUS PERSICA, L. (ROSACEÆ).

It seems to be a general rule that the sweetest, honiest peaches have usually a split stone. Africanus in the Geoponics[3], give directions how to raise the peach without stones.

PEACH PALM. GULIELMA SPECIOSA, MART. (PALMÆ).

The peach palm, says Humboldt[4], bears a fruit which is generally devoid of seed, owing to the extreme luxuriance of the vegetation. He[5] also says that the *piritu* or *pirijao* palm bears clusters containing from fifty to eighty fruit, yellow like apples, and purpling as they ripen, two or three inches thick, and generally, from abortion without a kernel. Seemann[6] says in most instances the seed is abortive, the whole fruit being a farinaceous mass. Occasionally, however, fruit are found containing the perfect stony seed, and they are then double the usual size. The tree is not found wild in the Amazon districts, but is invariably planted. Bates[7] says bunches of sterile or seedless plants sometimes occur at Ega and at Para. It is one of the principal articles of food at Ega while in season, and is boiled and eaten with treacle and salt. Prestoe[8] says the tree is extremely prolific, bearing two distinct crops a year, and sometimes more. At one season all seedless fruit are produced, and with a greatly enlarged fruit pulp, while at the other season only seeded or fertile fruits are produced. The

---

1 Ellis, Polynesian Researches, i. 374.
2 Gard. in India, p. 234.
3 Geop. lib. x. c. 16.
4 Views of Nature, p. 161.
5 Humboldt, Trav. ii. 336.
6 Popular Hist. of Palms, p. 208.
7 A Naturalist on the Amazon, p. 268.
8 Rept. of the Bot. Garden of Trinidad, 1880, 39.

seedless fruits are highly appreciated by all classes, both unripe as well as ripe.

PEAR. PYRUS COMMUNIS, L. (ROSACEÆ).

This fruit is botanically a pome, a fleshy fruit with the calyx adherent, and forming along with the epicarp or skin and the mesocarp or pulp, a thick cellular mass which is eatable, while the endocarp is scaly or horny, and forms separate cells enclosing the seeds. Its varieties are exceedingly numerous. Pliny[1] enumerates forty-two kinds as known to the Romans, and Columella[2] names eighteen sorts. Macrobius[3], as quoted by Gesner, also furnishes a list, from which Gesner[4] quotes with other Roman authors as furnishing twenty praiseworthy varieties. In Tuscany, in the times of the Medici there were catalogued two hundred and thirty-two kinds[5]; Le Jardinier Solitaire, 1612, describes fifty-five varieties in France; Meager, in his English Gardener, 1683, gives a list of one hundred and five; Knoop, in his Pomologia, 1760-6, figures one hundred and eighty-four kinds in color; Mawe, in his Gardeners' Dictionary of 1748, enumerates ninety-five; Don, in his Gardeners' or Botanists' Dictionary, 1832, gives a classified list of six hundred and seventy-seven sorts; Field, in his Fruit Culture, 1886, offers a catalogue of eight hundred and fifty varieties, of which six hundred and eighty-three are of foreign and one hundred and sixty-seven of American origin.

The more delicate varieties of pears, such as the Gansel's Bergamot and the Chaumontelle, says Lindley[6], have rarely any seeds. On the other hand, R. Manning, deservedly a high authority on pears, tells me that certain varieties, such as Vicar of Wakefield and Beurre Diel have most of the seeds abortive, and the first named is not a delicate pear. The coreless pear[7] is frequently destitute of seeds, but always contains the cells. The flesh is apt to decay at the core. It is a good bearer, but the fruit is ex-

1 Pliny, lib. xv. c. 16.
2 Col. de re rust. lib. v. c. 10.
3 Saturnalia, 2. 15.
4 Gesner. Lexicon Rusticum, 1788.
5 Targioni-Tozetti, Hort. Trans. 1854, 159.
6 Lindley. Theory of Hort., 1859, p. 170.
7 Gard. Chron. 1843, 737.

tremely liable to be shaken down by the wind; a very fine baking pear. Another account[1] states that many varieties occasionally are devoid of seed, but Belle de Bruxelles or the Poire sans Pepins is always so.[2] An account is also given of a Chaumontel pear which bears seedless crops.

Second crop pears are invariably seedless, says R. Manning. I have always found them so whenever I have had opportunity for examination. An instance is given[2] of second blooming bearing double flowers, and I have observed the same in the case of strawberries in autumn bloom. On February 17, 1880, N. Plumadore, of Raleigh, N. C., writes me that some third crop pears were entirely seedless, having nothing but a small stem-like thread clear through the pear. The Poires sans pierre was mentioned by Estienne[3] in 1570. The Bessemiawka, a Russian fruit of recent introduction, is nearly or quite seedless[4].

I have counted the seeds in but a few pears. The figures follow:

Variety.	*Number of Specimens.*	*Av. Wt. of Fruit. Ozs.*	*Av. Wt. of Seed. Grs.*	*Av. No. Plump Seed.*	*Av. No. Total Seed.*
Buffum,	5	2.9	6.17	6.2	10 0
Flemish Beauty,	1	5.5	7.71	4.0	6.0
Nowell,	1	3.7	3.39	4.0	9.0
Sickle,	5	1.5	5.2	4.8	9.2

PEPPERS. CAPSICUM, SP. (SOLANACEÆ).

The most acrid peppers are crowded with seed. Sweet peppers as a class contain but few seed. Such are also subject to develop a berry or berries within the berry, these enclosed fruit either containing a few seed or entirely seedless. In some varieties, as the yellow Nocera and Spanish Monstrous, seedless specimens are of not unusual occurrence.

PERSIMMON. DIOSPYROS VIRGINIANA, L. (EBENACEÆ).

I have frequently been told of seedless persimmons. Mr. Saunders, Superintendent of the garden at the Department of Agriculture, informs me that he has frequently seen such. Mee-

1 Gard. Chron. Oct. 17, 1885, p. 491.

2 Gard. Chron. 1866, p. 901.

3 Estienne. L'Agric. Maison Rustique, 1570, 133.

4 Budd. in Iowa Ex. Sta. Bull. Nov. 1888, p. 72.

han mentions such in the Botanical Gazette for March, 1885, I think. J. M. Pearson[1] writes, "I have seen some of our native kinds without any seeds, of which the fruit was delicious."

PINEAPPLE. ANANASSA SATIVA. (BROMELIACEÆ).

This is a multiple fruit, only the ovaries or pericarps never or seldom ripen any seeds, but all are blended with the floral envelopes, the bracts, and the axis of the stem they thickly cover, into one fleshy and juicy mass There are many varieties. In 1768 Taylor described five sorts; in 1737 Miller described five; in 1769 Speechley spoke of fourteen; in 1822 Miller of ten; in 1831 George Lindley of thirty-seven; in 1834 Rogers of nine; Mr. Munroe, a more recent writer, of fifty-two[2] In the Transactions of the Horticultural Society of London, fifty-two sorts are described. The greater number have been introduced into England from abroad, but several have originated from seed in England[3].

This is a typical seedless fruit, none, as Lindley[4] says, except the Enville now and then, having seeds, and this variety, though a large one, is of little value for its delicacy. Pineapples are more frequently seedful under the bad cultivation of the Continent than in the highly kept and skillfully managed pineries of England. New varieties are produced from seed, as was the case with the King pine[5], which was raised from a seed taken from a West Indian fruit. Schomburgk[6] says the wild pineapple in Guiana is small, yellow, aromatic, stringy and full of seeds, rather acidulous in taste. Piso[7] describes a wild *ananas* containing seeds. Humboldt[8] found pineapples of delicious quality growing wild in the Orinoco, and often the seeds were not abortive. Wild pineapples are mentioned by many observers, but nothing is said

1 Ill. Hort. Soc. Trans. 1878, 89.

2 McIntosh, Book of the Garden.

3 Hort. Trans. 2d ser. i. p. i.

4 Theory of Hort., 1859, 170, 171.

5 M'Intosh, Book of the Garden, II. 642.

6 Rawleigh's Disc. of Guian. Hakl. Soc. ed. p. 74, note.

7 Piso, Bras. 1658, p. 196.

8 De Cand, Geog. bot. p. 926, quoted.

about seed in those references we have consulted[1]. A white kind which in the East Indies has run wild, is said by Unger[2] to still contain seeds in its fruit. Hughes[3] in the Barbadoes mentions the seed as being very small and almost kidney-shaped, as if he had seen them. Rumphius notes a semi-wild pineapple in Amboina, bearing seeds, austere and rarely eaten. Arruda in Brazil speaks of a pineapple with small seeds, for the most part abortive[4].

PISTACIA. PISTACIA VERA, L. (ANACARDIACEÆ).

The pistacia, says J. Harlan[5], in his Fruits of Cabul, yields a crop of fruit one year, followed always by a crop of blighted fruit. The latter is like the former in external appearance, but is somewhat larger and quite destitute of kernel.

PLUM. PRUNUS DOMESTICA, L. (ROSACEÆ).

A stoneless variety of the plum is described by Duhamel[6] and by Downing[7], who says the fruit is small, the flesh greenish, harsh, acid, and the kernel without any stone surrounding. As Darwin says[8], the kernel lies in a rough cavity surrounded only by the pulp.

In the richest, sweetest large plums, it cannot have escaped observation, that we have often the splitting of the stone within the fruit, as in the peach.

Prunus Americana, Marsh., is subject in New Brunswick to an anomalous form, which render it seedless and inedible[9]. I have observed this occurrence in Maine, the seed swollen, pulpless, seedless and tasteless. Sometimes the remnant of an embryo is to be found. This monstrosity seems more often to occur when the spring season is cold and rainy[10], and is perhaps due to a fungus attack.

---

1 Montiero, Angola, p. 101. Afzelius (for Sierra Leone) quoted by Sabine. Hort. Trans. v. 401. Titford (Jamaica), Hort. Bot. Am. p. 54.

2 U. S. Pat. Off. Rept. 1889, 331.

3 Hughes. Barb. 1750, p. 230.

4 Roem-et Schult. 7, 1284.

5 U. S. Pat. Off. Rept. 1861, 533, notes.

6 Duhamel du Monceau. arb. fruit, 1768, ii. 110.

7 Downing, Fruit, 1885, p. 949.

8 An. and Pl. i. 417.

9 Hooker's Journ. of Bot. iii. 99.

10 See Dr. Harris in Hovey's Mag., viii. 247.

An examination of a few samples of plums gave the following figures:

Variety.	*No. Samples.*	*Av. Wt. Fruit Grs.*	*Av. Wt. Seed Grs.*	*Per Cent. Wt. of Seed to Fruit.*
Smith's Orleans,	10	736.0	18.2	2.47
Jefferson,	10	348.4	8.5	2.44
Frost Gage,	8	245.3	8.6	3.50
Suisse,	10	439.0	13.4	3.05
Fellenberg,	10	383.5	17.0	4.43
Golden Gage,	10	379.6	13.9	3.66
Bingham,	10	511.8	25.1	4.90
Blecker's Gage,	10	279.3	13.9	4.98
Hudson's Gage,	10	254.9	13.1	5.13
Pond's Seedling,	10	517.7	19.0	3.67

POMEGRANATE. PUNICA GRANATUM, L. (LYTHRARIEÆ).

This is a peculiar baccate many-celled fruit, having a tough rind formed by the calyx, enclosing two rows of carpels placed above each other. The seeds are immersed in pulp, and are attached irregularly to the parieties, base and center. This pulp is apparently formed by the placentas. It is a fruit in much esteem in many localities in the Orient. Ibn-al-awam[1], a Moorish-Spaniard of the twelfth century, describes eleven varieties.

The pomegranate, with the ancients, was a mystical fruit, on account of the profusion of its seeds, typifying procreation, increase and abundance. There are many varieties. Capt. Burton[2] describes three in Arabia. The *Shami*, almost stoneless, and an exceedingly fine fruit; the *Turki* and the *Misri*, from the context seeding, and not of as fine quality. Barnes[3] says Kaja is famed for its pomegranates without seed, although by far the finest are brought from villages half way up the mountains. The tree only grows in a few Afghan villages. Harlan[4] enumerates the seedless pomegranates from Jillalabod among the fruits in the markets of Cabul. Barnes[5], in his Travels in Bokhara, remarks on the pomegranate seeding in Magenderan as a remarkable peculiarity. In India, the best fruits, having sweet juice and very

1 Le Livre de l'Agric., d' Ibn-al-awam, 1864, i 252.

2 Pilgrimage to El Medina and Mecca, i. 388.

3 Cabul, 1842.

4 J. Harlan, U. S. Pat. Off. Rept. 1861, 530.

5 Darwin, An. and Pl. ii. 205, note.

small seeds, come from Cabul[1]. Hasselquist[2] observes the inhabitants of Cyprus called a variety having a small stem and barren flowers *Balaustia*. In 1860 cuttings from a seedless variety from Palestine, described as bearing fruit much esteemed in Syria, were distributed from the United States Patent Office[3].

This seedless fruit was mentioned also by the ancients. Pliny[4] says the sweet pomegranates known by the name of *apyrena* are generally considered to be injurious to the stomach. He further describes this *apyrena* as being seedless, of a whiter color than the others, and of a more agreeable flavor. In the Geoponics[5] Africanus gives directions how to raise pomegranates that shall be seedless, and so also does Palladius[6] and Columella[7] from hearsay.

POMELO. CITRUS DECUMANA, L. (RUTACEÆ.)

A seedless variety of the Pomelo is said to be grown in Florida, as Mr. Vandeman informs me.

PUMPKIN. CUCURBITA, SP. (CUCURBITACEÆ).

According to the experience of Ch. Naudin, when the *Cucurbita maxima*, *C. Pepo* and *C. moschata* are crossed, no seed or only sterile seed are produced[8]. I have also observed that the finer quality squashes and *C. moschata* pumpkins contain fewer seed than those of inferior quality. In the Barbadoes[9] there are mentioned by Hughes four kinds, the white, the blue, the marbled and the garden pumpkin. "The latter differs from all the rest by having no seed; but is propagated by slips."

RASPBERRY. RUBUS, SP. (ROSACEÆ).

In some observations made on the number of seed[10] to a berry, the *Davidson's Thornless* averaged 34.2; the *Caroline* 47; the

1 Dutt. Hindw. Mat. Med. 166.
2 Voy. and Trav. in the Levant, 1766, p. 247.
3 U. S. Pat. Off. Rept., 1860, 34.
4 Pliny, lib. xxiii. c. 57; lib. xiii. c. 34.
5 Geoponics, lib. 4. c. 7; lib. 10, c. 31.
6 Pall. lib. 3, c. 29.
7 Col. lib. v. c. 10; also Col. arb. c. 23.
8 Darwin, An. and Pl. i. 430.
9 Hughes, Barb. 1750, p. 137.
10 N. Y. Ag. Ex. Sta. Rept. 1882, p. 80.

Clarke 57.6 seed to a berry. In some reported trials[1] the seedlings from few-berried fruits gave distinctly better quality but smaller size fruit than corresponding seedlings from many-seeded berries. The trials were with *Rubus occidentalis* varieties.

RIBES ALPINUM, L. (SAXIFRAGACEÆ).

Thory says he has often found seedless berries upon whole branches of fruit of this species[2].

SAPPODILLA PLUM. ACHRAS SAPOTA, L. (SAPOTACEÆ).

The medlar-like fruit of the Sappodilla plum, of a milky, quince-like taste, is much esteemed in tropical America and India. It has usually from six to twelve cells with several seeds in each, but Swartz[3] remarks that most of the seed are usually lost by cultivation.

SERVICE. PYRUS LANUGINOSA, DC. (ROSACEÆ).

The flowers and fruit of this tree resemble those of the mountain ash, but are smaller, the flowers are frequently abortive, and the fruit, when it is produced, is generally without seeds.

STRAWBERRY. FRAGARIA, SP. (ROSACEÆ).

In this fruit the enlarged and conical receptacle bearing the pistils on its surface, becomes the edible portion in fruit. The varieties are endless, and the various classes have been referred to different species. Merrick,[5] in 1870 catalogues eight hundred and thirteen kinds. The name *Strawberry* refers to the running stems strewed (anciently *strawed*) over the ground. This reminds us of Virgil's description " * * humi nascentia fragra." Servius Grammaticus, A.D., 412, calls them "fructus terra et mora terrestria," the equivalent of which is found in the Swedish and Danish name of *jordbar*, earth berry. Pliny's name was also *terrestris fraga*, ground berry. The earliest picture of the strawberry that I possess is in Herbarius cum Herbarium, Mogwntiæ, 1484, chap. lxiii., which is evidently of *Fragaria vesca*, as

1 N. Y. Ag. Ex. Sta. Rept. 1885, 257. See also ib. 1855, 257.

2 Thory. Grosseilier, 20.

3 Miller's Dict., Ed. of 1807.

4 Loudon, Arb. p. 924.

5 Strawberry Cultur. 1870.

the fruit is borne above the leaves. The figure is a rude one, but recognizable.

A mule plant from the Hautbois and Alpine strawberry, says Knight[1], blossoms very freely and its blossoms set well; but the growth of the fruit subsequently remains very nearly stationary during the whole period in which the Hautbois strawberry grows and ripens; after which it swells and acquires maturity. It is then rich and high flavored, but of less size than the Hautbois, and without seeds. Duchesne[2] remarks upon the sterility of the Breslinge, known in France under the name of *Covcov.* It is not completely sterile, however, but has produced a strawberry of fine flavor, the *Fraises mignones.* Mr. Saunders of the Department of Agriculture at Washington, told me February 16th, 1880, that he once had a bed of pistillate strawberries which fruited but bore no seed; the quality was fine. In my own trials I have found that the most superior varieties have contained fewer seeds to the berry than other varieties of inferior quality.

In some countings of seed[3], fine specimens averaged seed to a berry as follows: Hervey Davis, 115; Triumph de Gand, 152; Monarch of the West, 232; Sharpless, 239. This corresponds in order very closely to the quality. Small, inferior samples of Wilson's Albany, however, had but seventy-two seed to a berry.

TOMATO. LYCOPERSICUM ESCULENTUM, MILL. (SOLANACEÆ).

It is a matter of common observation that the finest quality tomato fruit contains fewer seed than do those of inferior varieties. Burr[4] also says there is a seedless variety, smooth and handsome, with few seeds.

A fair sample of four varieties gave seed as follows:

Variety.	*Wt. of Fruit Grs.*	*Seed to a Berry.*	*Wt. of Seed Grs.*	*Per cent. Seed to Berry.*
Mayflower,	1419	244	6.5	.38
Paragon,	3834	531	21.6	.56
Trophy,	3208	476	22.6	.70
Early Acme,	3449	491	24.7	.71

1 Knight, Phys. and Hort. Papers, p. 276.

2 In Lam. Enc. Meth. 1786, ii. 535.

3 N. Y. Agric. Ex. Sta. Rept. 1882, p. 80.

4 Garden Vegetables, p. 208.

Watermelon. Citrullus vulgaris, Schrad. (Cucurbitaceæ).

The watermelon was observed by Caesalpinius[1] in 1583, in a seedless state, and this is quoted by Bauhin in 1596 and 1623, as alss by J. Bauhin in 1651. I find no other recorded instance.

In the above list of sixty-one species, we find quality either stated or inferred, in varying degrees, in the case of thirty-three; in the remaining twenty-eight either no, or insufficient, mention. It is more than probable that in every case of high development, for thus we class horticultural selections, the seed is changed in some respect from the seed of the wild type, either recognizable in reduction of number, size, weight or fragility. In many instances, such as the melon and tomato, the orange and the peach, and many others, this is effected through corelations, the horticulturist indifferent to the seed, but keen for the quality of juiciness, tenderness and flavor. It seems a legitimate field for horticultural effort, to experiment with seed from nearly seedless forms, or with seed which is more fragile or seemingly imperfect, in the endeavor to produce increased quality, as also with seed from unripe fruit.

1 Caesalpinus, lib. 5, c. 5, p. 200.

INDEX.

Achras sapota, 183.
Allium cepa, 173.
Amygdalus Persica, 176.
Ananassa sativa, 179.
Artocarpus incisa, 154.
Berberis vulgaris, 153.
Brassica oleracea, 156.
Capsicum, 178.
Cerasus vulgaris, 157.
Chamærops stauracantha, 156.
Citrullus vulgaris, 185.
Citrus aurantium, 173.
  decumana, 182.
  Limetta, 168.
  medica, 158.
  medica, var. Limonum, 168.
Cratægus Azarolus, 150.
Cucumis Melo, 171.
  sativus, 159.
Cucurbita, 182.
Cycads, 161.
Dioscorea aculeata, 162.
Diospyros Kaki, 167.
  melanoxylon, 162.
  schi'tse, 162.
  Virginiana, 178.
Eugenia Malaccensis, 169.
Fagus ferruginea, 154.
Ficus carica, 162.
Fragaria, 183.
Garcinia Mangostana, 170.
Gulielma speciosa, 176.
Lagenaria vulgaris, 163.
Lucuma bifera, 169.
Lycopersicum esculentum, 184.
Mangifera Indica, 169.
Mespilus Germanica, 171.
Morus, 171.
Musa, 150.
Myrtus communis, 172.
Olea Europæa, 172.
Opuntia Davisii, 173.
  Ficus-indica, 173.
Persea gratissima, 149.
Phœnix dactylifera, 161.
Pistacia vera, 180.
Prunus Americana, 180.
  domestica, 180.
  laurocerasus, 168.
Psidium Guayava, 166.
Punica granatum, 181.
Pyrus communis, 177.
  lanuginosa, 183.
  malus, 145.
Ribes alpinum, 183.
  rubrum, 160.
Rubus, 182.
Spondias dulcis, 175.
Vitis Labrusca, 164.
  vinifera, 165.
Zizyphus Lotus, 169.

[Issued May 30th, 1890].

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. II. No. 1.

Reserve Food-Materials in Buds and surrounding Parts.

(With Plates I and II.)

BY BYRON D. HALSTED.

ISSUED SEPTEMBER 10th, 1890.

PRICE, 50 CENTS.

MEMOIRS

OF THE

Torrey Botanical Club.

VOL. II.

PUBLISHED FOR THE CLUB.
Sept., 1890—Dec., 1891.

CONTENTS.

No. 1.

	Pages
Reserve Food-Materials in Buds and Surrounding Parts (Plates I and II). By **Byron D. Halstead**	1–26

No. 2.

Contributions to the Botany of Virginia. I. Notes on the Spring Flora of Southwestern Virginia (Plates III and IV). By Anna Murray Vail (with annotations by N. L. Britton, and a list of Mosses by E. G. Britton. II. Notes on the Autumn Flora of Southeastern Virginia. By Arthur Hollick	27–56

No. 3.

Contributions to the Knowledge of the Germination of some North American Plants (Plates V–XIX). By Theodor Holm	57–108

No. 4.

The Genus *Polygala* in North America. By Wm. E. Wheelock	109–152

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

Vol. II. No. 1.

RESERVE FOOD-MATERIALS IN BUDS AND SURROUNDING PARTS.

By Byron D. Halsted, Rutgers College, N. J.

The purpose of this paper is to consider the structure and reserve food-contents of the buds and surrounding parts in some of our trees and shrubs, with occasional reference to nourishing substances as stored in other parts of perennial plants.

Particular attention will be paid to starch, because this is one of the most important constituents of the assimilated food of plants, is stored away in a granular form and admits, by means of its pronounced and characteristic reaction with iodine, of being easily detected and definitely located in the tissue bearing it.

Buds are the free extremities of branches, or, to place the same idea in a different form, they are incipient branches, whether located upon the free extremity or along the side of a stem. In the former case they are called terminal, and in the other lateral buds. As to their relation to growth they may be active, that is undergoing elongation or branch formation, or dormant, as illustrated by them in winter. It is with these last that this paper will have most to do, for it is in preparation for the inactive period that buds become most highly developed, and their tissues charged with the nutritive food-elements that are so much needed to push the plant forward during the unfolding in spring. Buds are again divided, as to their future development, into those that will produce

blossoms, called flower-buds, and those destined to grow into ordinary stems, and to bear the foliage of the plant. One set of buds become specialized, and are devoted to the particular function of reproduction, while their neighbors continue their growth and maintain the plant itself. The leaf-bud looks only to the future of the individual, while the flower-bud carries with it the idea of a new plant that in time is to flourish separately. In external appearance the buds of various trees and shrubs differ so greatly that they may well form a part of a full description of any plant. It is not our purpose, however, to go into any consideration of their sizes, shapes, colors and other peculiarities. Those buds that are herein treated have first of all a covering of scales accompanied by more or less of a lining of fur, and frequently in addition a varnish, all of which serve the important purpose of preventing access of water and the sudden changes of temperature that might otherwise bring death to these seats of vitality. The protective layers that a plant places over the tender substance of a growing point suggest the same provision for its own safety when hard times come as do the thick, impervious coats that are wrapped round the germ of a future plant as found ensconced in the seed. Within the bud-scales, which may be few or many, thick or thin, etc., there is the point of growth now in a quiescent condition. It is somewhat conical, possibly almost flat-topped, but from below it and upon all sides there arise a number of lateral outgrowths, in regular order, the youngest being nearest to the top, and these curve upward and overtop the growing point. These greatly disguised leaves are the first ones to unfold when the bud develops into a stem, while at the same time new ones are produced in close proximity to the advancing point of growth, thus continuing the bud as it pushes forward, leaving behind a young stem with its developing foliage. In case of the flower-bud, if it be one formed in autumn, as that of the apple, peach and similar fruits, there are the same bud-scales, but instead of a growing point that will develop into a branch, there may be one or several miniature flowers which, when the scales are thrown back, quickly open out into the fragrant blossoms.

It is a matter of common observation that buds, and particularly those producing blossoms, open with rapidity, burst, as it is termed, and there is no corresponding formation of substance out of which to grow at that period in the life of the plant. It follows, therefore, that there must be a reserve of formative material stored somewhere in the plant for the purpose of supplying the needed nourishment at this important and dependent annual period in the life of every tree and shrub. If we should consider seeds as to their minute structure, we should find that besides the plantlet there is frequently a large mass of lifeless substance stored in contact with the embryo, as in corn, and often enveloping it. This liquifies in germination and yields to the unfolding plantlet ample support until it can thrust its roots into the soil, lift its fresh leaves up to the air and sunshine and shift for itself. In many seeds, as the bean, the embryo is large and gorged with the food-material that the parent plant has provided for it.

There are many points of agreement between a seed and a winter bud. Both are constructed for a period of inactivity, and protected from untoward influences by thick layers of impervious substance. Both start into growth under the same quickening influences of vernal warmth and moisture, and in fact the buds of some plants, as those of the Indian shot-lily, regularly become detached, fall to the ground and are the starting-points of new plants. This is an important point in proof of the similarity of structure of seeds and buds. We should, therefore, naturally infer that at some place in every bud, or near by, there is a reservoir of those substances that are needed for its initial growth at least. A study of this point is now before us.*

---

* The investigations, the results of which are herein presented, were begun during the winter of 1888-89, when, continuously for two months at the Iowa Experiment Station, the reserve food-substances in apple-twigs were studied in a score or more sorts, including a wide range of hardy and tender varieties. The results as then obtained appeared in Station Bulletin No. 4. During the past year, in spring, summer, autumn and winter, the work has been extended to include a large number of species of ligneous plants and the roots of many perennial herbs.

STRUCTURE AND CONTENTS OF TERMINAL BUDS.

The terminal buds seem the most natural place to begin the consideration of the subject before us. In a general way, in the introductory notes, the structure of these buds, situated at the ends of shoots, has been pointed out, and it is for us now to pass more deeply into the subject, and with the aid of the microscope determine the minute anatomy of these points of conservation of vital energy. As before said, the leading component parts are the overlapping bud-scales provided with more or less hair and varnish, within which is the bud proper, that is, the incipient shoot, bearing its leaves as minute outgrowths which are arranged in a definite (acropetal) order; the large outer ones inclose the younger and smaller ones, the central point of all being the extremity of the stem. As in all newly formed vegetable tissue endowed with the subtile power of further growth, the cells that compose the central portion are small, thin-walled, and their contents consist largely of that colorless semi-fluid and extremely variable substance called protoplasm, the acknowledged vehicle of vital activities. Below this cone of delicate and almost homogeneous cellular tissue the stem is seen to take its origin with the differentiation into the cylinder of wood cells and vessels, having upon its inner side the comparatively unchanged pith, and, without, a thin layer of active cells that is to continue the growth in size of the branch by developing upon its inner surface new layers of wood, while outside is produced a protective substance familiarly known as bark. Therefore, by mentally combining transverse and longitudinal sections of the base of a terminal bud, the observer is able to determine the method of formation of the various elements that go to make up an ordinary twig. The young leaves that are a part of the dormant bud while still very small present but little more than the simple cellular condition common to the short tip of the branch that bears them. Among the outermost it is possible to distinguish the details of form and outline, together with the venation and other points of differentiation determined by a microscopic examination of newly unfolded leaves. Of course, the

distance to which this work of bud-growth extends, varies greatly within and outside of the species, and is not a matter to concern us farther at the time.

RESERVE FOOD-MATERIALS.

Plants which live from year to year do not use up all the nourishment prepared by the green parts, principally the leaves, during the season of active growth. They lay by a portion of this material to be employed in the vital processes at times when the plant cannot assimilate the crude substances which are obtained from the soil and the air. In short, perennial plants, during the growing season, store some of their elaborated substances in places where it becomes available for nutrition in the early spring, while the plant is putting forth its young twigs and leaves. This reserve material, as it is termed, may for convenience be divided into two groups: namely, those which are known as carbohydrates; so called because consisting of carbon and the elements of water, that is, of carbon, hydrogen and oxygen, united in definite proportions. The leading carbohydrate is starch, familiar to every one as the basis of many foods for animals and man, as found in potatoes, corn, and a long list of other vegetable products. Oil is another reserve form assumed by the carbohydrates, and abounds in many seeds and other parts of plants. Sugars, which by themselves make up a group of the carbohydrates, are often found associated with the other forms of reserve food-material above mentioned. There are other forms of carbohydrates, but they do not specially interest us in this paper.

The second division of reserve material, suitable for plant nutrition, is known as albuminoids, so named from a resemblance to the albumen or white of egg. Protein is another term given to the same group of substances, all members of which agree in having nitrogen in their composition—a substance which is absent in the carbohydrates. They are more complex and less stable compounds than the carbohydrates, and are stored usually as amorphous contents of cells. Sometimes, however, they assume the form of grains (aleurone), or crystal-like bodies (crystalloids), and in these condensed conditions may be met with in seed, like beans and peas, which are

usually rich in the albuminoids. The proteids are the basis of protoplasm, and protoplasm is the substance which is invariably present in every living cell. As protoplasm is the complex compound in which life always manifests itself, the importance of the albuminoids out of which protoplasm is made, becomes self-evident.

Doctor Vines, in his new work,* in treating of the repose of the above compounds, says: "When once deposited the reserve materials undergo no change, or, at most, the proteids may slowly undergo some alteration, so long as the organ in which they are deposited remains in an inactive condition. An organ in this state is practically dead for the time being, all its metabolic processes being arrested. It is capable, moreover, of resisting injurious influences, such as extremes of temperature and desiccation, which would prove fatal to it, were it actively living. It is obviously in consequence of this property possessed by such organs during what we may term this state of suspended animation, that vegetation is maintained in regions in which the cold of winter is severe, and in arid tropical regions. The time of the possible duration of this state, without permanent loss of vitality, varies very widely." It is well known, for example, that some seeds retain vitality for a long time, especially starchy ones. With the quickening influences of warmth and moisture supplied by spring-time, the reserve materials undergo changes which convert them into substances that can readily travel to seats of vital activity when they are employed in growth.

Starch.—Returning to the carbohydrates, they will be taken up in the order of their importance. The test for the detection of starch is the very satisfactory one of iodine solution; which turns this substance blue, while it fails to produce the same color in other cell contents. By means of this reagent, starch is found quite generally at a short distance below the growing point, and usually in the form of compound granules, the component parts of which separate quite easily. These masses, or compound granules, vary greatly in size, and the smaller particles of starch do not exhibit this compound nature. Starch-bearing cells of well-matured twigs may con-

---

* "Physiology of Plants," 1886, p. 172.

tain hundreds of these granules, when they are completely filled with the nearly spherical masses.

The relative position of the starch varies greatly with different buds, especially in widely separated species of trees and shrubs, but in those that are well matured, upon the same plant, there is a fair degree of constancy.

At this point it is necessary to state that there are two classes of terminal buds, so called, among ligneous plants, with some gradations between them, not a little confusing. There are those which are characteristic of plants, with a well-defined habit of growth, that is, those that lengthen their shoots for a definite period, as in the horse-chestnut, for example, and then spend the balance of the growing season in forming a large terminal bud, and supplying it with nourishing food for the next year's development. On the other hand, there is a large group of trees and shrubs, and especially brambles, that grow on indefinitely, produce no plump, terminal bud for winter, usually kill back, and therefore must start the farther elongation of the twig from some lateral bud perhaps a foot or more back from the end of the stem. It is needless to say that the remarks to follow obtain only with the first class, and the consideration of the second will appear later, because less simple.

In order to make a careful, microscopic study of the cell elements of a terminal bud, it is necessary to secure several thin sections with a sharp razor, made in various directions through the bud. One of the most satisfactory is made lengthwise through the middle of the bud, and from this the position of the food-elements, after a little experience, can be determined with a fair degree of accuracy. This is said, not to discourage the making of horizontal sections, which are necessary for the demonstration of some important points, but to facilitate the work of those who may choose to extend the investigation herein outlined.

Figure 1 shows such a section through the terminal bud of an apple-twig, made in February, 1890, and therefore during a remarkably warm winter. The feature to be first observed is the dark column in the lower center (*a*) of the figure. This is the pith of the subadjacent stem, the cells of which are

starch-bearing; this fact being indicated by the darkness in imitation of the color produced in this part of the section by a solution of iodine. At b and c are the scars of the last two leaves of the previous season, and from them pass inward and downward the vascular tissue that gives elasticity and strength to the twig. Other similar but smaller vascular threads are seen above, receding from the bases of the bud-scales, and uniting into a cylinder of woody tissue, still in a formative condition. The remaining part of the bud consists of small, many-sided cells packed together, a large number of them bearing complex, sphere-shaped crystals of oxalate of lime, while others are filled with semi-solid substances composing an impure form of protoplasm. The feature of most interest in this connection is the sharp line separating the starch-bearing cells of the pith from those in the younger pith just above, in the contents of which starch is entirely absent. There is a definite localization of the starch, as a rule, in or near all terminal buds that are fully matured. In those gathered before the processes of growth are completed, the starch may be scattered in all parts of the soft tissue, and especially in that portion lying between the zone of wood and the rind.

Besides the presence of starch, there is another marked difference between the pith indicated by the shading and the younger portion above, containing the albuminoids and crystals. The latter, it has been said above, is composed of thin-walled cells, and not materially different from those in all other parts of the bud. But the starch-bearing cells have their walls much thickened, and in such a manner that canals are left extending from the original cell wall to the free interior. These canals of adjoining cells meet at the juxtaposed walls, so that provision is thus made for the ready transfer of material from one part of the storage tissue to any other. In figure 2 is shown a portion of the tip of the starch-bearing pith in the terminal bud of a Duchess pear, and the adjoining thin-walled pith. At this line, which is usually somewhat convex, the tissue will often give way in making the sections, leaving the firm, thick-walled pith with a ragged edge. A few of the starch-bearing cells, highly magnified to show the details of their canaliculate structure, are shown in figure 3.

In making a longitudinal section of a terminal bud with a sharp knife, the operator quickly learns to detect the starch pith as soon as it is reached in the downward passage of the instrument. The bud proper is cut with ease, but there is a sensation known to grafters and others as that of "grittiness," which is due to the resistance to the knife caused by the many thick walls of the starch-bearing cells. This is one of the most important modifications of the ordinary cell wall, and consists of a thickening due to the intercalation into it of a substance called lignin, which chemically differs somewhat from cellulose, and adds materially to the hardness and durability of the tissue lignified. This power of resisting external influences is gained, however, at the loss of much elasticity. Lignified cells do not abound in protoplasm, but water passes freely through their walls. All permanent, inactive tissue may become lignified, and when this process is freely carried out it yields the durable heart-wood so familiar in many kinds of timber. The subject is of interest because it helps to explain the matter of "grit," or "grittiness," so frequently spoken of by those who cut the twigs of various sorts of fruit-trees. The inflexibility of tips of certain plants is due in most parts to the large amount of lignin their pith contains.

The free end of a mature twig consists of a cone of minute, thin-walled cells, upon the outside of which the small, imperfect leaves, as bud-scales, arise in regular order, and, overlapping each other, enclose the tender growing point of the twig. From the scales, bundles of fibers and vessels descend and form a thin ring of wood around the pith just below the growing point. At this portion of the twig the pith makes up the greater part of its substance. In short, the bud, the stem, and for a quarter to a half inch below it, are composed of soft tissue, easily crushed with the thumb and finger. But below this the large central pith is particularly rigid, due to the unusual thickening that has taken place in the walls of the cells. If the reader will bear in mind that the wood zone is very thin at the upper part of the twig, and that the bast is almost wanting, it will be evident that the pith alone must give the rigidity found near the extremity of matured twigs. From the shape of the nearly spherical cells it follows that

there can be no very great toughness. Contrariwise, brittleness characterizes the upper portion of a well-matured twig, and for two or three inches below the terminal bud it will often snap, almost like a pipe-stem, when sufficient side pressure is applied.

Sugars.—Tests for other carbohydrates were made, principally the various sorts of sugars.* Grape sugar was generally present in variable quantities in all terminal buds. Cane sugar and dextrine were likewise present in most cases, but in small quantities. Grape sugar was most evident near the growing points, and cane sugar, if it appeared at all, was in the fine, unlignified tissue at the base of the bud. In view of the fact that starch is readily changed into sugar within the plant, under conditions similar at least to those surrounding the twigs when gathered for testing, it follows that sugar, which in this connection may be considered as another term for soluble starch, would be expected, and in variable quantities. Twigs gathered directly from trees also showed these sugars in small amounts.

Albuminoids or Proteids.—This group of complex and very variable substances does not readily admit of separation into individual sorts, and is therefore treated as a whole. Proteids are present in all living parts of ligneous plants, and are most abundant near the points of greatest vital activity. In the apple, for example, there is little or no albumen in the pith at the base of an old twig, very little in the wood zone, an abundance in the cambium layer, and the largest percentage in the buds. In these last places, when the buds are mature, the albuminoids make up a large part of the cell contents, to the exclusion of the starch. All the varieties studied exhibited the albuminoids as brick-red particles when treated with the Millon test, a nitrate of silver compound, described elsewhere. On account of the conspicuous color the presence of the protoplasmic compounds is easily demonstrated. When the tip of a twig was still soft, spongy and without rigidity from a failure of the pith to lignify, there was only a feeble response. Protoplasmic matter was present, but so scattered

* The methods observed in the micro-phytochemical study of these carbohydrates will receive separate treatment at the close of the paper.

over a large area of cellular tissue that no distinct line or point of coloration developed, as is true of buds which have become ripe.

The albuminoids, therefore, like the starch, from their behavior in green and ripe twigs, become a test of maturity. These complex compounds are the ones out of which protoplasm forms, and afterward renews its strength. They are the most important reserve materials in the sense that they stand, in composition, nearest to that of protoplasm, which is the acknowledged vehicle of vital activities. It is not unnatural that these compounds, in a resting twig, should be stored in the buds where they are to be needed the coming spring. Starch may, therefore, be excluded from a well-equipped bud, because other substances of greater consequence, and accumulated in smaller quantities, are conserved at the points of growth. In other words, there is a manifest tendency for the concentration of reserve materials at points where they are to be used, and in the order named; first the albuminoids, and next the carbohydrates—first the basis of protoplasm, and next the substance protoplasm must use in the building up of new tissue, and in other vital processes. Following upon this is the conclusion resulting from the investigations, namely: that, other things remaining the same, the best-conditioned twig is the one having a sufficient amount of reserve material within easy reach, and in the best condition for the use of the plant. A well-preserved bud is therefore plump with reserve substance in a comparatively solid condition, being firm but not woody; is well protected from the injurious effects of very sudden extreme changes of temperature, and has close at hand a sufficient amount of starch, or other carbohydrates, for its most advantageous development. Whether one form of bud, as to its length, breadth and thickness, color or number, and hairiness of scales, may be better than another under any special condition, is a question more likely to be determined by field trial than by laboratory tests. Plants, seemingly equally hardy, may have the vital points very differently constructed. No matter along what line the problem has been worked out by the species, the chief point is to prepare for hard times, and having once made the prepa-

ration remain quiescent until the coast is clear for another year of growth. The inherent tendency of one introduced variety of plant to start into growth before another may throw it into the class called tender, while another with the same structure, but differently disposed, will prove hardy. The test for sugar in the late winter may aid in deciding that a difference in this tendency exists, for starch, the chief form in which the carbohydrates are stored up in many kinds of twigs, is changed into sugar before it becomes available for plant nutrition.

Crystals.—A few words concerning these structures, which were constantly met with in all buds examined, will be sufficient for this portion of the subject. Vegetable physiologists are agreed that true crystals (not including crystalloids) in the tissue of plants are a form of refuse, or left-over matter, resulting from the processes of growth, and put up in a consolidated form, to get them as much out of the way as possible. Some one has compared them to the pieces of brick, mortar and other material thrown into boxes and barrels during the construction or repair of a building. Crystals were rarely found in the old pith, and have not been seen in the wood, but are very abundant just below the growing tips of all buds in that cylinder of tissue connecting the free extremity of the bud with the starch-bearing cells—a half-inch or so back of the tip. The loose green bark of all parts of the twigs also abounds in these bodies, and they are especially numerous in the cellular tissue that lies between the leaf scar and the bud above it. In this locality, a second form is often met with, which is smaller and rectangular in shape, while the prevailing sort is an irregularly spherical aggregation of sharp-angled bodies, which have taken the name of sphæro-crystals. These crystals are composed of oxalate of lime (calcium oxalate) and may be dissolved by mineral acids.

From the composition of these bodies, their universal prevalence in about equal numbers, first in proximity to tissues which are the centers of rapid vital processes, and secondly, in out-of-the-way places, and for various other reasons, it is safe to conclude that crystals are no safe criterion by which to judge of the relative resisting powers of plants to

the untoward influences that may surround them. One would as soon think of deciding upon the stability of a house or bridge by the number of chips that the builders have made.

Tannin.—Like crystals in vegetable tissues, tannin is considered as refuse matter, and not, with perhaps certain exceptions, further active in the vital processes of the plant. Tannin, as recognized by salts of iron, is abundant in twigs, and in transverse sections is found most common in the rind, and the inner bark close upon the cambium, and between it and the zone of bast. There is a great difference in the amounts of tannin between the several species. The buds contain more than the other portions, and in immature terminal buds the tannin is quite generally diffused throughout all parts of the soft tissue.

COMPARISON OF VARIOUS SPECIES.

The reader is now prepared to make a comparative study of the food-materials in the terminal buds of some of our leading kinds of trees and shrubs, confining his attention for the present to those with well-developed buds at the extremities of the branches. In the horse-chestnut we have a typical illustration of buds with large and therefore conspicuous parts. A longitudinal section is made with great ease, and there is noticeable absence of the grit found in many twigs. The pith is very large, and at an inch or so below the bud it is dry and filled with air. The starch deposit occupies a thimble or nipple-shaped portion of the moist pith, above which is the growing point with its proteid compounds. Instead of growing for a long distance at the least expense and strengthening the upper portion by a deposit of lignin in the pith, the wood zone continues of considerable thickness, and the buds rest in this ring as a crayon is held by its handle or clamp. Figure 4 illustrates these points better than can be described in words. The small amount of starch present may be due to the warm winter, for the varnish was much softened at the time of gathering (February 20), and the moist (almost wet) pith was filled with a mixture of the soluble carbohydrates and the albuminoids ready for the initial growth.

In remarkable contrast with the last are the clusters of

buds at the ends of twigs, as in the cherry, oak, etc. The tip of the twig is enlarged; the wood zone is thin, but there is a corresponding lignification of the great mass of pith, thus giving stability to the end of the shoot and furnishing a reservoir for a large supply of starch from which the several buds can draw liberally when they need this nourishment.

The maples offer a case of buds being in pairs, and therefore there are three very near to the extremity of the twig—the terminal or central one and two lateral buds. In the hard maple (*Acer saccharum*, Marsh.) the disposition of the starch suggests a thimble or a finger of a glove, it forming a narrow layer, in the pith that lies next to the thin zone of wood. In the soft maple (*Acer saccharinum*) the thimble has no tip, but is like a "glove finger" that has been cut off near the end. This may arise from the fact that the lateral buds are not so close to the terminal one.

The ashes are like the oaks in having a large amount of starch near the terminal buds. On the other hand, the catalpa resembles the soft maple in having a "thimble."

In the locust we have an illustration of a poorly formed terminal bud, and the starch distribution is accordingly peculiar. The treatment of such cases comes more properly under the head of lateral buds, but they form a transition between the terminal and lateral. The starch of the upper two inches of the twig is distributed quite equally between the two buds either of which might receive it all. In the basswood there is much the same condition of things, and in the hackberry also.

Among shrubs the lilac is a striking example of copious starch-storing at the tips of the branches, but in this case it should be remembered that two large buds are located terminally and two shoots must be provided for instead of one. Figure 5 shows the quite constant condition of the shrub in winter, and as this plant has been studied throughout the year it will be treated of elsewhere.

The garden cherries have terminal clusters of buds as in the oak, only larger, but the amount of starch is small. The same is true of the wild cherries. However, a large amount of gum or mucilage is present, and this doubtless serves the same purpose as starch in the economy of the plant.

Plums have much more tapering twigs, and end in minute terminal buds, but with considerable starch located in a cone of lignified pith, as has been mentioned for the apple and pear. In the peach the terminal bud is large, but the starch is much less abundant than in the pear and apple; it is midway between the pear and the cherry in respect to its starch-bearing, and perhaps holds the same position as to the amount of mucilage or gum.

There are many species of trees that do not usually present any starch in the twigs of the last year's growth, among which are the various kinds of willows and poplars, but the older wood of the main branches, as a rule, contains more or less of this food substance. Among shrubs the elder and currant and gooseberry have but a small amount of starch in the vicinity of the terminal buds. In short, there seems to be no evident rule to guide one in the matter. Starch may be in abundance in one species when least expected and almost absent from another.

Other Carbohydrates.—An explanation of the absence of starch in many twigs is not far to seek. It may be due first to the substitution for it of oil, as in many seeds as well as buds and twigs. The pine family is a striking illustration of this, in the buds and branches of the members of which a pitch abounds, largely to the exclusion of starch. Sugars of the various sorts in like manner may take the place of starch in furnishing the carbohydrates needed for the growth of plants. In the second place, starch may have been deposited, but afterward changed into those closely related chemical compounds that, being soluble in cell sap, are ready for transportation and work. Rarely does a mature bud not respond to the Trommer and Fehling tests, but those without starch in their vicinity indicate the largest amounts of the soluble starches, as they are sometimes called. In this connection it may be said that the wood of the common currant bush was thoroughly examined because of a failure to find starch in the young twigs. When the roots, however, were tested, it was found that they abounded in starch. Albuminoids and sugars were present in the ends of the twigs, while the storehouse of starch was below ground.

LATERAL BUDS.

In general structure the lateral buds closely resemble the terminal ones, but are much smaller, and have a somewhat different attachment to the twig. The soft cone of small cells rests upon an abbreviated stem from which the outer scales arise. Where the bud is connected with the twig there is an interlacing ring of fibers and vessels, and within this is a central pith, which is modified as spoken of while treating of the terminal bud; that is, the cells are very thick-walled, having undergone the process known as lignification, a characteristic of the durable parts of most ligneous plants. As the lateral buds are often close to the twig upon one side there is a consequent lack of symmetry. The exposed surface naturally has a greater development of the protective layers, the bud-scales being both thicker and more numerous upon the outside than next to the stem. There is also more of the red coloring matter in the exposed parts. Over all parts there may be a coating of soft down consisting of colorless hairs which grow from the epidermal or outer layer of cells of the bud-scales and the body of the twig. As the twig matures this hairiness is quite easily removed, so that its presence or absence in midwinter is largely accidental.

Flower-Buds.—As a general thing, the conditions that surround a flower-bud are necessarily much the same as those of the leaf-bud. Both are incipient branches, and while one is destined to elongate into a twig, bearing ordinary foliage, the other remains comparatively short and produces disguised leaves for the purpose of reproduction. It is true, however, that while the leaf-bud soon becomes self-supporting, and in fact finally makes the starch for the next season's use, the fruit-bud is a source of loss to the plant, and therefore needs to be provided with nourishing food-materials. On this account it is natural to expect that the fruit-buds should be specially favored in the location of starch and albuminoids.

Flower-buds usually are not strictly terminal, that is, at the extremities of main twigs. However, there are exceptions, and the treatment of flower-buds does not fully fall under either of the two groups of buds already considered.

Thus in the peach the flower-buds are not at the ends of the shoots, but instead are here and there along the twig in the position of, and easily distinguished from, the lateral leaf-buds by their larger size, extreme hairiness, etc. Not infrequently there are three buds at a node and raised upon an abbreviated spur, but in such cases the central one is a leaf-bud, and the two lateral ones each contain a flower. The apple, in somewhat the same manner, has lateral spurs, at the end of which is a bud containing three or more immature blossoms apparently terminating the branch, but in fact only overreaching a dwarfed leaf-bud situated somewhere among them.

In the horse-chestnut is an illustration of the center of the large terminal bud being occupied by a flower-cluster which when unfolded is a foot or more in length, and bearing possibly a hundred blossoms. This flower-cluster, at first terminating the stem, soon takes a lateral position by the development of a leaf-bud that continues the twig.

A large number of flower-buds have been examined during the past winter, both to determine the disposition of the reserve substance and to make notes of the influences of the warm weather. As far as the storage of starch, sugars and albuminoids is concerned, it can be briefly stated that there is no material difference between the fruit and the leaf buds, except that the latter are usually larger, lack the light green interior, characteristic of the young parts of leaf-buds, and contain within and near them a greater supply of the albuminoids, backed up by a lignified starch-bearing tissue. Not being strictly terminal, the fruit-buds are well located for the immediate storage of starch in the wood and pith of adjoining parts.

In the fruit-buds of the peach there is an interesting case of the special localization of starch that has not been found in those of apple, plum, cherry, quince, or in fact any other blossom-buds subject to examination. Without entering into a description of the peach blossom, it may be said that there is a single pistil centrally located, about which the other parts are disposed—the calyx as a cup bearing the stamens upon its inner surface. In figure 6 a peach-bud is seen in longitudinal section, with its upper part of fuzzy bud-scales removed, exposing in the center of all the pistil a, and next the stamens b.

All of the base of the bud c is charged with albuminoids and carbohydrates that do not respond to the starch test. When the wood, d, of the twig is reached, it is found filled with starch, as indicated by the shading. Near the base of the pistil, or miniature peach, is a triangle of starch-bearing tissue. Occasionally, starch is also found in the pistil and the stamen-filaments. These last need to undergo rapid growth at time of blossoming. Whether this starch was stored in these parts, far away from the great reservoir of this material, during the growing season, or has been laid down afterward, is a question that is not answered. It is, however, a well-known fact, that starch can be deposited, then dissolved, and re-deposited in another place repeatedly within a short time when such a change of the carbohydrates is of advantage to the plant. A study of the formation of the callus, and of the knitting tissues of grafts, is interesting in this respect. It is, however, true, that when the flowers develop the reservoir at the base of the peach pistil becomes emptied of starch, and the tissue, not being thick-walled like ordinary starch-bearing cells, is similar to that around it.

TRANSVERSE AND LONGITUDINAL SECTIONS OF TWIGS.

An ordinary twig of the last season's growth consists of the following parts : (1) A central cylinder of pith which runs the whole length, ending at the tip in the terminal bud. This pith consists of many-sided cells, which are about as long as broad, and packed so closely together as to leave but few cavities, called intercellular spaces, between them. The cells nearest the center are usually largest, and the outermost smallest, and have the thickest walls. (2) Next outside of the pith is a ring or zone of wood, which is very thin at the upper end of the twig, but gradually becomes thicker as the basal end is approached. This wood consists of long ducts or vessels running longitudinally in the twig, and surrounded by slender, thick-walled flexible wood cells. The wood is the most substantial part of a twig, and makes up the greater part of any tree. In the wood ring of the twig are thin plates of pith-like cells, which reach from the pith to a thin

belt of cells, capable of growth, situated just outside the wood, and called the cambium layer. These plates of thin-walled cells, known as the medullary rays, are here especially mentioned, because they play an important part in the storage of the reserve food-substance formed by the plant during the growing season, and stored away to be employed during the initial growth in early spring. Besides the vessels, wood cells and medullary rays in the wood ring, there are also long, rectangular starch-bearing cells, in many respects not unlike the pith, extending lengthwise of the wood, and at right angles to the general direction of the medullary rays. These may be styled the wood-pith cells. (3) The cambium layer, above mentioned, is made up of small, thin-walled cells, and constitutes the soft layer at which the wood and bark may be separated, especially in spring. The radiating plates of pith cells which reach from the pith to the cambium layer, and above designated as the medullary rays, project beyond the cambium, and broaden out in the loose, cellular part of the bark that lies between the somewhat interrupted ring of bast and the cambium. (4) This bast is the tough fibrous part of the bark, and consists of small bundles of thick-walled cells which run lengthwise of the twig, and are usually midway between the rind and the cambium. (5) Upon the exterior of all is a double layer of thick-walled cells. The outer may be styled the cuticle, and beneath this is a much thicker layer of firm tissue, with the contents of many of the cells colored green. The outer and thinner layer bears much of the coloring matter which gives mature twigs their characteristic reddish, brown or other color. Between the rind and the ring of bast is a belt of loose, cellular tissue abounding in cavities between the cells known as intercellular spaces. This is the loosest tissue in the twig, and may be called the pith of the bark. It, however, differs from the true pith in the center of the stem in having the cell contents colored green. It is often and appropriately called the green bark, and is the part exposed when the thumb-nail removes the rind of a twig but does not pass deep enough to reach the wood layer.

Therefore, to recapitulate, the twig in cross-section consists of the following parts, beginning at the outside: A double

rind or protective covering of thick-walled cells more or less impervious to water, and bearing the matter which gives the twig its color. Within this is a broad, loose belt of green cells and large intercellular spaces which reach to the tough fibrous band of bast. Succeeding the bast, passing inward, is another loose belt of cellular tissue narrower than the one outside the bast into which the medullary rays project as they pass through the cambium layer. Next, within this cambium, is the wood with its medullary rays which reach to the central cylinder of pith. The outer portion of the pith, the medullary rays, and the pith wood-cells at right angles to the latter, are the three portions of the internodial part of a twig that are starch-bearing. The above description considers only sections that might be made through the twig at any point between the buds. At the nodes or points where lateral buds are developed there are certain modifications of the structure which have been considered.

JUNCTURES.—At the point of union or junction of two years' growth of a twig, as of that found during 1889 and that of 1890, there are but few structural features not included in the description of the twig already given. The point is easily determined from the outside, for the scars of the several scales of the terminal bud of the previous year remain to mark the place, which is somewhat larger in cross-section than the twig, an inch or so above and below it. It also is a starting-point from which the buds become more distant, proceeding either up or down the twig. If these points are not sufficient, the brighter, fresher red of the more recent growth will be quite sure to distinguish the place of union. With a cross-section of the twig under the microscope, the age in years is quickly determined. The first wood formed on a yearling twig in spring is more porous than that last produced the previous autumn. It is on this account that the wood of an old branch is arranged in evident rings, and if there has been no interruption in the growth of the plant during any summer there will be a ring for each year, the thickness and porosity of which will vary with the season's favorableness for growth. Microscopic inspection of the juncture does not reveal any very marked modification of structure. The cylinder of pith is

larger here, often twice the normal diameter of that just above or below; its cells are smaller and thicker-walled and inclined to be elongated and arranged in longitudinal rows, as if to add rigidity to this portion of the twig during the early spring growth, and give general stability at a point where elements of weakness naturally obtain from the union of the wood of two different years. Below the juncture the pith contains a cone or thimble, the outer cells of which are usually tinged with brown as if dead, and in shape and position it accords with the exterior of the lignified pith which has been mentioned as beginning a short distance below the base of the terminal bud. With certain chemical reagents and coloring materials this thimble or cone of pith, surrounded by structurally almost identical tissue, behaves the same as that at the top of a well-matured twig, and easily met with by cutting down through the terminal bud lengthwise with a razor or sharp knife. It is evident, therefore, that as the terminal bud undergoes development in the spring, the soft thin-walled cells at its base become lignified, and while they are finally apparently the same in structure as the cells below them which were lignified the autumn before, the line of separation is not obliterated, but instead may be usually observed, without the aid of a magnifier, by making a longitudinal section through the juncture.

The point that most interests us in this connection is the important part which the juncture plays in the storage of reserve material, and especially starch. Having become adapted for this service while situated in the vicinity of the terminal bud, the lignified pith cells continue for several years in the same capacity, and probably at no time become entirely free from these substances. Trees and all starch-bearing shrubs exhibit this fact, but some much better than others. For example, the pear is shown in figure 7 as a type of the large class of trees. Figure 8 is of the honey locust, which is without a well-formed terminal bud, and the branch is each year continued by a lateral bud. Twigs with opposite buds, which, of course, from what has been seen of the relation between buds and starch storage, have the amount of food-reserve doubled at any one transverse plane of the node, are

illustrated in the ash, figure 9. In the lilac, as before mentioned, there are practically two terminal buds, and this leads to another form of juncture shown in figure 10.

Some extremely slow-growing horse-chestnuts and ailanthus trees, found in a rocky situation near New Brunswick, N. J., present striking illustrations of the point in hand, because what is usually found in a twig of several feet in length is condensed into as many inches. The ailanthus, figure 11, illustrates the method of killing back of the tip each year, and the renewal from a lateral bud. In fact, everything has gone so irregularly that the storage of starch at the junctures is far from uniform. In the *Æsculus*, figure 12 a, the case is very different, and the progress, although small, is quite uniform. Looking at this twig from the outside, there is one almost continuous display of bud-scale scars, so that the age of the branch could be determined only with much difficulty. On the other hand, by splitting it through the middle, the empty, thin-walled, colorless sections of pith are quickly seen as alternating with those of a brownish tinge. But the greatest difference is manifest when half of such a twig is laid for a few moments in a dish containing iodine, and afterward washed in alcohol. It is then that the blue sections of pith are seen to correspond to the basal part of each successive terminal bud, and the empty pith separates them. The starch-bearing cells in the *Æsculus* are not as much lignified as in most twigs, and for this reason, when they lose their normal amount of moisture by exposure, will shrink, leaving depressions in the pith channel at these points, while the empty, colorless pith between them retains its plump form indefinitely. An examination of a similar *Æsculus* stem, made July 30th, showed that only a small fraction of the starch still remained, and with almost none in the bud itself. At b, in the same figure, the parts of a rapidly grown, long horse-chestnut twig are shown in contrast with the slowly developed branch at a.

SPINES AS RESERVOIRS OF FOOD.

A study of the winter contents of the thorns of honey locust, hawthorns, wild crab-apple and the Japan quince, etc.,

leads to the conclusion that these sharp means of defense serve another purpose, perhaps only secondary, besides that of protection. Upon examination for starch, it was found that there was an unusually large per cent. in the thorns. A thorn of a honey locust, for example, when examined in midwinter is found to consist of a horny exterior, within which is a dry, somewhat powdery, snuff-brown mass, containing no starch. Near the base of the thorn at that place where it is sometimes flexible in its attachment to the stem, when growing, for example, upon the bole of the tree, the central pith is firm throughout, of a greenish color when freshly cut, and packed with starch. In figure 13, at a, is shown a longitudinal section, through such a thorn. It is also seen by the same figure that the starch diminishes rapidly in amount, passing upward from the thorn, while below it remains of about equal amount until the lower of the series of buds below each spine is passed.

The position of thorns being near the bud favors the idea of their serving as places for the storage of starch, for when thus laid away for the winter it is close at hand for use when the growing days of spring arrive. The relative amount at the base of the spine, and below at the point bearing the buds, is shown in the cross-section b, and not only is there more within the stem at the juncture of the spine, but the base of the latter is more thoroughly gorged than any other part of the tree. At c is a section shown midway of the internode.

In the hawthorns the structure of the base of the thorn is somewhat different. Omitting the discussion of the minute structure of the spine it will be sufficient to call attention here to figure 14, in which the starch, the darkened portion, is seen to occupy the pith of the twig, making a V-shaped structure at the base of the spine. In addition to this, there is a somewhat triangular starch-bearing portion above and below the pith of the base of the spine. In some specimens the starch extends for nearly a half-inch into the spine, but as a slender point.

In the wild crab (*Pyrus coronaria*, L.), the spine is more like an ordinary branch, because usually bearing buds upon its

exterior, and has the starch-bearing pith extending for a half of the way, from the base to the sharp, hard tip. In the main twig there is a manifest accumulation of starch at the base of the spine, as is shown in figure 15. Figure 16 shows a fruit-spur, the center of which is filled with starch for the purpose of providing abundant nourishment for the development of the cluster of flowers.

Many other examples might be cited, but that of the Japan quince (*Cydonia Japonica*, Pers.) will suffice. The spines of this favorite hedge plant were examined in February, while some of the blossoms had already expanded, due to the very warm winter of '89–'90. The position and relative size of the parts are shown in figure 17. It will be seen that the flower-stem is short, and the spine joins it at the base. In figure 18 the condition of the starch storage becomes clear. There is no starch in the flower-spur, but an abundance in the interior of the spine, to be withdrawn to feed the flower and the leaves that afterward come upon the stem.

It is very likely that the spines are primarily for the warding off of enemies, but if we can look upon the protective organs as serving another purpose it adds further dignity to the police department, so to speak, of the plant.

METHODS AND REAGENTS.

STARCH.—For the detection of starch, as before stated, the solution used was iodine made as follows: three grammes of crystallized potassium iodide were dissolved in sixty c. c. of distilled water, to which was added afterward one gramme of metallic iodine. This solution was diluted as the occasion required. The microscopic inspection for starch was with thin sections either treated at once with the iodine solution or after they had received potassic hydrate to remove the protein compounds that might otherwise obscure the reaction. When the presence of starch was established its abundance and general distribution was determined by splitting the bud or twig, or both, and immersing the parts for a few minutes in a long porcelain trough, when the degree of darkening of the various parts of the section gave the amount of starch

present. By removing the twig to a bath of alcohol for a minute the subject was cleared up, and the location of the starch-bearing portions could be made out more distinctly. If desired, thin sections could be taken from the treated surface for microscopic study.

SUGARS.—The sugars of various sorts are usually associated with each other, and only the presence or absence of the group was usually attempted. Trommer's test is a simple and satisfactory one: Place the slices or sections in a porcelain dish, add a strong solution of cupric sulphate and heat to boiling. Wash the specimens thoroughly, and add hot potassic hydrate, when the presence of dextrine and grape-sugar will be shown by a reddish precipitate. To separate these two sugars, treat the original tissue to alcohol, standard strength, for a few hours, which will dissolve away the grape-sugar, when the dextrine can be tested for as before. Cane-sugar, with Trommer's, gives a bright blue color in the cell contents, quickly vanishing, but no red precipitate. It is well for the student to make tests with this reagent of vegetable tissues containing large quantities of each one of the leading kinds of sugars. Fehling's solution, which is a modification of the above, may be employed. In place of the pure cupric sulphate solution, one of one part of the cupric sulphate and five parts of potassium sodium tartrate in eight parts of water may be used. This reagent needs to be kept in the dark.

ALBUMINOIDS.—For these Millon's reagent was employed. This is prepared by adding to metallic mercury an equal weight of concentrated nitric acid. When all is dissolved add twice the volume of pure water. Place the tissue in a porcelain dish, add a little of the reagent and heat, when a rose or brick-red precipitate indicates the presence of albuminoids. A dark yellow, with nitric acid, and a yellow or brown with iodine also indicate the same substances.

CRYSTALS.—There are two leading salts in the form of crystals in plants, the carbonate of lime and the oxalate. The crystals having been detected with the microscope, acetic acid may be added, which will dissolve the carbonate with effervescence, but does not act upon the oxalate.

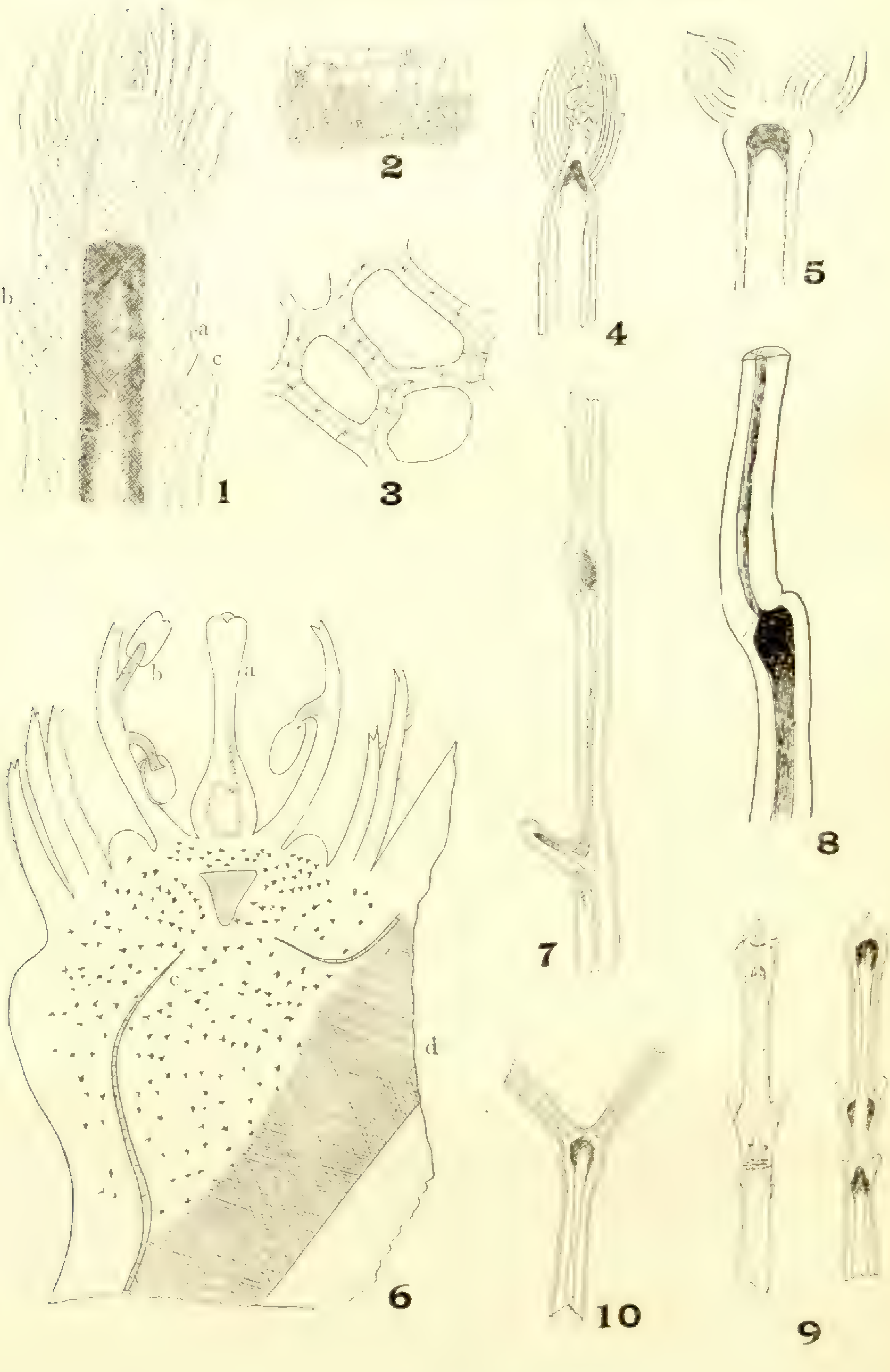
TANNIN.—The various iron salts give with tannin a very

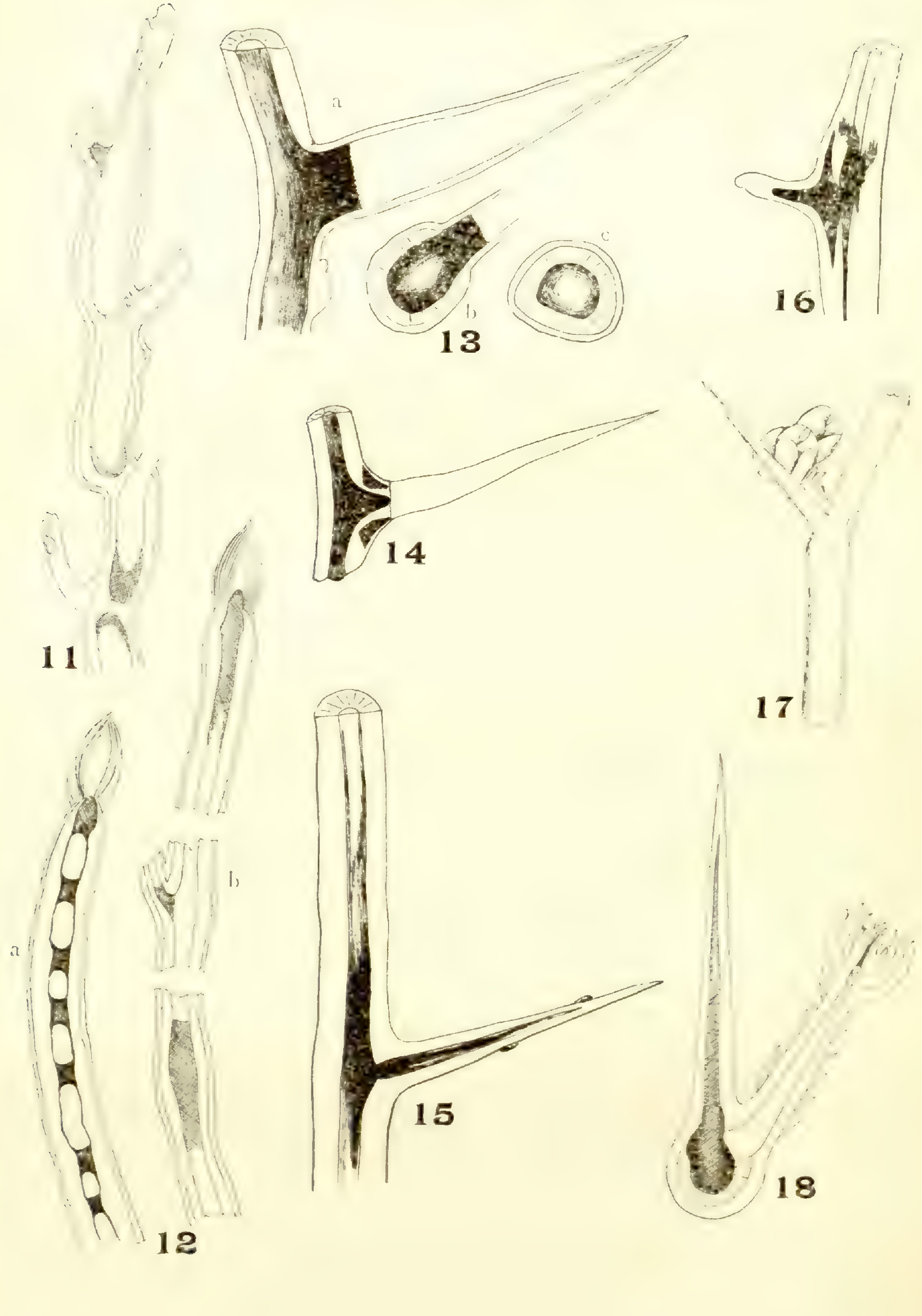
dark color, therefore ferric chloride may be employed for its detection.

LIGNIN.—Carbolic acid dissolved in concentrated hydrochloric acid gives a green color with lignin, and hydrochloric acid and alcohol develop a beautiful rose color after some hours.

The works most frequently consulted for methods in the studies contained in this paper have been "Behren's Guide to the Microscope in Botany," by Hervey, and "Goodale's Physiological Botany." Upon the general subject much assistance can be obtained from "Sach's Vegetable Physiology," "Vine's Physiology of Plants," and "Strasburger's Das Botanische Practicum." The most elaborate paper consulted is a "Memoire sur la Moelle des Plantes Ligneuses," with numerous elegant plates, by A. Gris, in "Nouvelle Archives du Museum d'Histoire Naturelle, 1870."

RUTGERS COLLEGE,
July 21st, 1890.


1
2
3
4
5
6
7
8
9
10
a
b
c
d


11
12
a
b
13
a
b
c
14
15
16
17
18

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. II. NO. 2.

Contributions to the Botany of Virginia.

I.—Notes on the Spring Flora of Southwestern Virginia. By ANNA MURRAY VAIL. (With annotations by N. L. BRITTON, and a list of Mosses by E. G. BRITTON.) Plates III and IV.

II.—Notes on the Autumn Flora of Southeastern Virginia. By ARTHUR HOLLICK.

ISSUED DECEMBER 23d, 1890.

PRICE, 75 CENTS.

MEMOIRS
OF THE
TORREY BOTANICAL CLUB.

Vol. II. No. 2.

NOTES ON THE SPRING FLORA OF SOUTH-WESTERN VIRGINIA.

By Anna Murray Vail.

Plates III and IV.

A long, dusty ride in the latter part of May, from Washington to Roanoke, was the beginning of our trip to Virginia. The country was interesting all the way, but the fleeting glimpses we had of strange plants and trees were, from a botanical point of view, more of an aggravation than a pleasure. During a short stop at Culpeper, *Crepis pulchra* * was gathered close to the tracks—a novelty in the line of introduced plants.

Roanoke, one of the most rapidly growing industrial towns in Virginia, is situated in a hollow closely surrounded by wooded foot-hills, and beyond them by the higher forest-clad ranges of the Blue Ridge, prominent among which are the twin sugar-loaf-shaped Peaks of Otter.

A short walk late in the afternoon of our arrival brought us to the high, rocky banks of the Roanoke River, where the

* *Crepis pulchra*, L. Sp. Pl., 806. Another European Composite to be added to our long list of introduced plants. It was observed in large quantities along the railroad, and has been determined by Dr. Porter. The specimens exactly match those from continental Europe.—N. L. B.

first plant collected was a *Clematis*, which, being erroneously described in the various Floras as *Clematis ovata*, Pursh, is now named by Dr. Britton, in honor of the President of the Torrey Botanical Club—*Clematis Addisonii.** (Plate III.)

---

* CLEMATIS ADDISONII. (*C. ovata*, Torr. & Gray, Fl. N. A. i. (1838), not Pursh, Fl. Amer. Sept. ii., Suppl. 736 (1814).

Ascending or erect, 1°–3° long, simple or bushy-branched, tufted, glabrous throughout, glaucous. Branches slender and often trailing. Lower leaves simple, entire or rarely 2-4 lobed, obtuse, deep bluish-green above, conspicuously glaucous beneath, sessile, clasping, 2′–4′ long; upper leaves pinnate and tendril bearing, of 2 or 4 ovate, sessile leaflets, or in small plants simple and similar to the lower; flowers solitary, terminal and sometimes also axillary, reddish or bluish-purple, nodding, ovate, 9″–15″ long, 5″–7″ broad at the base, narrowed toward the summit; sepals thick and leathery, lanceolate, acute, their tips recurved; stamens numerous, about equaling the sepals, glabrous below, pubescent above; achenia flat, nearly orbicular, blunt-margined, finely silky-pubescent; persistent styles 1′–1¼′ long, plumose throughout, the plumes brown; achenia 6–20 in each head.

This plant has had a peculiar and very interesting history. It appears to have been first collected many years ago by Le Conte in the mountains of North Carolina, and specimens of this collection are preserved both at Philadelphia and New York. It was also found by Baldwin in Georgia or Florida. The first allusion to it in print that I have come upon is in Torrey and Gray's Flora, where Pursh's name *ovata* was erroneously taken up for it, as it has also been by all subsequent authors who have had occasion to refer to it. Dr. Gray was the first to make this out, by an examination of Pursh's type in the Sherardian Herbarium preserved at Oxford, and in writing of the group of American species of *Clematis* with pinnate leaves in Bot. Mag., tab. 6594, he says, in describing *C. reticulata*, a coriaceous-leaved southern plant: "*C. ovata*, Pursh, of which the original specimens in Herb. Oxon. have leaves almost as reticulated as this when old, appears to be *C. ochroleuca*, Ait." In order to make sure of this, as from Dr. Gray's expression "appears to be" I suspected that he was not altogether certain about it, I sent abundant specimens of both the Roanoke plant and of *C. ochroleuca*, Ait., collected on Staten Island, to Professor Sidney H. Vines, the distinguished director of the Oxford Botanic Garden and Museum. He very kindly compared them with the *Clematis* of the Sherardian Herbarium, and reports to me as follows:

"It is a single branch, bearing four leaves and a single flower in fruit. It is numbered 1140, and bears the following label: 'No. 1140 Clematis virginiana, Pannonica similis, foliis amplioribus subrotundis. Pluk. Mant., Tab. 397, f. 4. Negroe's Head. Mr. Dale's specimen has larger and rounder leaves. Dr. Pluk. figure represents this, but ye leaves are trifida or tridentata.'

"On this label is penciled, 'C. ovata, Pursh Suppl.,' without indications of writer. Also in another hand, 'C. venosa, Ph. am. fl.'

"The specimen has no sepals which, according to Kuntze's recent monograph, are of classificatory importance. The form of the leaf does not exactly agree with that of any of the specimens you send. The leaves on our speci-

Of about 45 species collected that afternoon, the most notable were the little white-flowered *Sedum Nevii* growing

---

men are ovate-acuminate, coriaceous in texture, glabrous above, slightly hairy beneath and strongly reticulated on both surfaces. On the whole it more nearly approaches your specimens of *C. ochroleuca*, Ait., than it does those which you send as *C. ovata*, and we should be consequently inclined to refer it to *C. ochroleuca*, Ait. It certainly is not your *C. ovata*. In this conclusion we agree with Dr. Gray's note in the Bot. Mag. to which you refer.

"There is another specimen of *Clematis*—1139—in the Sherardian collection, which is labelled as follows:

"'Clematis erecta, humilis non ramosa, foliis subrotundis flore unico ochroleuco. Banist. Cat. Pluk. Mant. 51, T. 379, 65.'

"On this label is written in pencil, '*C. ochroleuca*,' and there is no doubt that the determination is correct."

It will be seen that this examination settles conclusively that our plant is not *C. ovata*, Pursh, and therefore must receive another name. The question next arises, What is *C. ovata*, Pursh? There seems still to be question as to its equivalency with *C. ochroleuca*, from which Pursh distinguished it, for he republished *C. ochroleuca*, Ait., as *C. sericea*. It was collected on Negroe's Head, which is a mountain of the southern Blue Ridge, while *C. ochroleuca* is, to my knowledge, not a mountain species at all, but grows in sandy or gravelly soil from southern New York to North Carolina. On the western side of Staten Island it occurs in almost pure sand on a dune.

In August of the present year I collected a number of specimens of a *Clematis* in fruit, high up on Kate's Mountain, at White Sulphur Springs, W. Va., which I supposed was *C. ochroleuca*, although quite surprised to find it in such a place. The soil was rocky and the plants smaller than those of *C. ochroleuca* generally are. On examining this critically, I find that it differs from the lowland plant in being almost glabrous, the lower-leaf surfaces and twigs of *C. ochroleuca* retaining their somewhat dense pubesence to the last. But the most striking difference is in the color of the plumose styles; they are grayish white, while those of *C. ochroleuca* are always brown; besides this, they are proportionately shorter. Judge Brown had previously called my attention to the great difference in color of the plumes in various species of *Clematis*, and it certainly seems to be a valuable character. After receiving the information above quoted from Professor Vines, I sent off specimens of this plant to Oxford, and have the following note from that gentleman, to whom I would express my sincere gratitude for the considerable trouble he has taken in the matter: "In reply to yours of November 10, referring to the *Clematis* question, I hasten to inform you that Mr. Druce and I have carefully compared the specimens of *Clematis* collected by you at White Sulphur Springs, West Virginia, with our specimen of *C. ovata*, Pursh. We have come to the conclusion that the two plants are identical. The texture and venation of the leaves and the fruit are remarkably similar in the two, but in our specimen the leaves are slightly more acuminate than in yours."

on the rocks, and a new variety of *Pentstemon lævigatus* *—the latter a handsome plant with white or light purplish flowers. We also found it later on the Peaks of Otter and at

---

Clematis ovata, Pursh, is, then, apparently a good species, evidently rare, and not yet collected in flower, so far as I can ascertain.

All authors have been mistaken in describing *C. Addisonii* as strictly erect. To be sure, nothing but the tops of small plants had previously been collected, and from the solitary flower and simple leaves this was the most natural conclusion. Some of the smaller plants are obliquely erect, but the relationship is with *C. Viorna* rather than with *C. ochroleuca*. *C. Viorna* was, indeed, collected and observed in considerable quantities on the same bluff, and readily distinguished by its long, trailing stems, sometimes attaining 10 feet or more, its smaller, always pinnate lower leaves, and acute leaflets green on both sides. It comes into bloom at least two weeks later than *C. Addisonii*. Several plants of an evident hybrid between them were also collected, having characters exactly intermediate, which may be called CLEMATIS VIORNIOIDES.

It is worth while recording that Pursh says in his description of *C. ovata*, that he considers the reference written in the Sherardian Herbarium to Plukenet's figure as not applicable to his *C. ovata*, because that figure represents a plant with tridentate leaves, and that he regards it as "an imperfect specimen of *Clematis* with compound leaves." However this may be, *C. ochroleuca* occasionally occurs with toothed leaves, and we may expect this in any one of the normally entire-leaved species.

This William Sherard, pupil of Tournefort, whose herbarium has been so important in working out the matter, was born in 1659 and died in 1728. He founded the Chair of Botany at Oxford, and attached to it his botanical library and herbarium of 12,000 species.

O. Kuntze, in Verhand. Bot. Ver. Brandenburg, xxvi., 176, 177, refers *C. ochroleuca*, *C. ovata* and also *C. Fremontii*, S. Wats., to varieties of the European *C. integrifolia*, making six subvarieties of *C. ochroleuca*. I believe that this is as unphilosophical a treatment of the group as could well be devised. He has also a subvar. *subglabra* of *ovata*, said to have been collected at Eagle Pass, on the Mexican Boundary Survey, and preserved in the Berlin Herbarium. I suspect a mistaken label as the cause of this publication, for there is no record in the Botany of the Mexican Boundary of any *Clematis* from Eagle Pass, and it is unlikely that any member of this group occurs in that part of the country. Mr. Joseph F. James, in his "Revision of the *Clematis* of the United States" (Journ. Cincin. Soc. Nat. Hist., vi.), records having seen the specimen marked *C. ovata* in the Philadelphia Herbarium, and says, "it is in appearance simply a small *ochroleuca*," but he could not have examined it very closely.—N. L. B.

* PENTSTEMON LÆVIGATUS, Sol. var. CANESCENS, n. var. More or less finely canescent all over, sometimes densely so, simple, 1°–2° high. Upper leaves sessile and clasping, ovate or ovate-lanceolate, 2′–3′ long, acute, dentate, those of the middle and lower part of the stem narrowed below the

Luray, and in every case growing with *Euphorbia corollata.* *Oxalis recurva* was in bloom all through the woods, and we found *Heuchera pubescens* and the pods of *Corydalis micrantha* on the rocks, and collected some splendid specimens of the high-climbing *Smilax Pseudo-China.*

In a swampy meadow we found *Veronica Anagallis* * growing with *Nasturtium officinale*, and all over the dry fields were patches of the pretty, purple *Verbena angustifolia* and *Delphinium Consolida*, the latter plant in three colors, dark blue, pink and white.

In a ditch on the edge of the town *Ranunculus sceleratus* † grew abundantly.

Early the next morning we left for Eggleston's in the beautiful New River Valley, and from there drove to Mountain Lake.

---

middle, so as to be somewhat fiddle-shaped, the lowest and those of the base contracted into long, margined petioles ; flowers purplish or nearly white, the corolla wide open, not bearded in the throat or very slightly so, 10″–12″ long ; sterile, filament slightly bearded for about one-third of its length ; pod ovoid, glabrous, slightly exceeding the calyx.

A plant of very different appearance from *P. lævigatus* or *P. Digitalis*, marked especially by its canescent, fiddle-shaped lower leaves. We have it also from Asheville, N. C., collected by Mr. Hogg in 1886, who also found what I suppose to be *P. lævigatus* there, and called my attention to the difference between them.—N. L. B.

* *Veronica Anagallis.* Our specimens are of the typical plant exactly matching European. The species has not hitherto been reported from so far south. The var. *latifolia*, Britt. (BULLETIN, XII., 49), is very different from this in habit and aspect, and is now known from numerous localities in New Jersey and eastern Pennsylvania, where the type has not yet been discovered, although occurring in central Pennsylvania and further west.—N. L. B.

† *Ranunculus sceleratus*, L. Very abundant in a roadside ditch, and evidently introduced. There are two forms of this species, if indeed they do not represent something more than forms. The truly native North American plant, so abundant along the edges of salt marshes and in saline situations in the interior, has thick, oblong heads of akenes, seldom more than two or three times as broad as long, and occurs also in northeastern Asia. The plants from Roanoke and some European specimens have narrow, linear heads, often four or five times as long as broad, and there appears to be a slight difference in the form of the akenes, while the plants with the broader heads have larger flowers. I have not enough material at present to indicate if they are specifically or variatally distinct.—N. L. B.

The guide-books advertise the drive as eight miles; our driver told us it was ten, adding that we might think it fifteen before we reached the hotel. The first part of the road was uninteresting, very hot and dusty and of the roughest description. Early during the drive we found *Viola striata* growing along the edge of a stony brook, a few specimens of *Phacelia parviflora* in a fence corner, and *Polygala Senega* on the border of the woods as we began the long ascent. In a small damp wood *Podophyllum peltatum* was in flower and *Caulophyllum thalictroides* in fruit, and near by we saw the bright, crimson stars of *Silene Virginica*.

As we drove along a narrow ravine higher up, we caught our first glimpse of *Rhododendron calendulaceum*, yellow, scarlet and crimson; its brilliancy and great variation of color were astonishing, and a constant delight to us all the while we were on the mountain.

The dainty flowers of *Vaccinium stamineum* were larger and whiter the higher we drove. *Vaccinium erythrocarpon* and *Menziesia globularis* were scattered along the roadside, and deep down among the dead leaves we found a few late blossoms of *Epigæa repens*, apparently as much at home there as it is many miles nearer New York. Among many groups of fine trees we noticed especially *Tilia heterophylla*, *Magnolia acuminata* and *Æsculus lutea* growing together, the latter in full bloom, with swarms of bees flying around its great panicles of creamy flowers.

Along the road, near the top of the mountain, *Gillenia trifoliata* and *Cypripedium acaule* were plentiful, and *Cypripedium parviflorum* was in its prime and very fragrant. The crowning excitement of the day was the finding of the beautiful *Convallaria majalis* and *Anemone trifolia** growing

---

* *Anemone trifolia*, L. Sp. Pl. (*A. nemorosa*, var., A. Gray, Amer. Nat., vii., 422.) An investigation of this interesting plant was the principal cause for the expedition. Mr. Canby had collected it on Salt Pond Mountain several years ago, and it had also been found by Mr. Curtiss on the Peaks of Otter. An authentic specimen from Germany is preserved in our herbarium, and I had

in close companionship among the stones. Our trip to Salt Pond Mountain was largely for the purpose of finding *Anemone trifolia*, and to see it so soon, and in such great quantities, was a pleasure, mingled with surprise that it should have been so long overlooked. (Plate IV.)

The hotel, a large and comfortable old-fashioned house, was reached at seven. It is 4,000 feet above sea-level, on the edge of a pretty little lake, surrounded on all sides by high forest-covered ridges. On the borders of the lake were dense thickets of *Rhododendron maximum* and *Kalmia latifolia*, to see which, when in flower, must alone be worth the journey to Virginia. Three delightful days were spent on the mountain exploring the woods in all directions.

---

compared it with one of Mr. Canby's. Both he and I had concluded that it was distinct from *A. nemorosa*. It occurs very abundantly in dry or rocky situations on all the higher parts of Salt Pond Mountain except the extreme, unwooded summit, growing often from between rocks, and varying from 6′ to 18′ or even more in height. It is thus very different in habit and habitat from the widely distributed plant of low altitudes, which has been by nearly all recent authors referred to *A. nemorosa*, L., of the Old World, but which I have maintained is specifically distinct, as did Linnæus and Barton. (See BULLETIN, xvii., 123.) Up to the present time I have been unable to learn of the occurrence of true *A. nemorosa* in North America. *A. trifolia* is readily distinguished from either by its greater size, different habitat, isolated geographical distribution at high altitudes, its proportionately broader and thicker leaflets, larger flower, more numerous akenes, and the majority of its root-leaves being only 3-divided, while those of *A. quinquefolia* are almost always 5-divided. Some plants of *A. trifolia* were found with the root-leaves 4, 5 and even 6-divided, however. *A. quinquefolia* also blooms much earlier. It is interesting to note the occurrence here of *Convallaria majalis*, also a European plant, and in America equally restricted in range to the higher southern mountains. *A. quinquefolia* was found plentifully along brooks and in moist places lower down on the mountain, but I found that I could always distinguish the two species. That they are, however, very closely allied there can be no question, but they are as distinct as many other Ranunculaceous plants commonly regarded as different species.

About half-way down the Peaks of Otter, along the road to Buchanan, we found a large patch of the plant, still stouter and with larger and broader leaflets than any noticed on the other mountain. At this lower altitude vegetation was much further advanced, and the fruit had entirely fallen from the plants collected at this locality. Careful search revealed no *A. quinquefolia* in the vicinity.—N. L. B.

The first excursion was to the summit of Bald Knob, about 500 feet above the hotel. On the north side of the rocks up there, *Saxifraga leucanthemifolia* grew abundantly with *Heuchera villosa* and tiny plants of *Asplenium montanum*, and the sunny slope was carpeted with *Viola pedata* and its beautiful pansy-like forma *bicolor*. Both *Clintonias* and the slender white *Chamælirium luteum* were at home just below the summit, and *Ilex montana** grew in close proximity to *Ribes rotundifolia*.

We explored the lake and its borders, but with the exception of a few plants of *Parnassia asarifolia* growing on old logs, and a few mosses in the water, of vegetable life there was none, nor much of animal life either, for the matter of that. According to the agent in charge of the property, the lake has frequently been stocked with fish, the outlet properly wired and protected, but from the day they were put in the water to the present time, never a fish, living or dead, has been seen, which is mysterious, to say the least.

In and around Little Stony Creek, the outlet of Mountain Lake, we saw quantities of *Trautvetteria Caroliniensis* growing with *Veratrum viride*, and close by on the edge of the marsh were the dainty white flowers of *Oxalis Acetosella* and *Tiarella cordifolia*.

We collected some old fruit vessels of *Epiphegus Virginiana*, and *Conopholis Americana* was seen in three localities on the mountain, and also in fruit later at Eggleston's. On the edge

---

* *Ilex montana*, Torr. & Gray, in A. Gray, Man., Ed. 1, 276 (1848), is the name which should be applied to the shrub which in all recent writings is called *I. monticola*, Gray (Man., Ed. 2, 264, 1856). Dr. Gray changed the name in the second edition of the manual, after ascertaining that there was already published a *Prinos montana*, Swartz Fl. Ind. Occ. i., 622 (1797). It was in the second edition, and not the fifth, as is erroneously quoted by Dr. Watson in his Bibliographical Index, and by Professor Trelease, Proc. St. Louis Acad., v., 347, that Dr. Gray first proposed to merge *Prinos* in *Ilex*. But *Prinos montana* is not *Ilex montana*, which binomial was subsequently taken up by Grisebach (Flor. Brit. West Ind., 147 [1864]), for Swartz' plant. This is the species which must receive another name, and several seem to have been associated with it.—N. L. B.

of the Hemlock woods was found the gloomy-looking, ill-scented *Trillium erectum* and the high-climbing curious *Aristolochia Sipho.*

The hillside above the creek was a bewildering mass of bright flowers. A great patch of the brilliant *Castilleia coccinea* grew in the hottest, dryest slope among the bushes. *Rhododendron calendulaceum* was abundant, taller, and, if possible, even more startling in color than any seen before, and near by grew the rose-colored, fragrant *Rhododendron canescens*,* a striking contrast to its more brilliant neighbor.

Trillium grandiflorum was conspicuous for its large showy white or pink petals. *Trillium erythrocarpon* was past its prime, but we were fortunate enough to find a few plants that still showed their delicately veined flowers. *Disporum lanuginosum* was in fruit, and *Uvularia puberula* common on the hillside.

Violets were plentiful everywhere. Two yellow ones, *Viola pubescens* and *Viola hastata*, were still flowering, and in shady nooks the large, shiny leaves of *Viola rotundifolia* were conspicuous, but of the latter we had to content ourselves with fine fruiting specimens only. A big bed of *Viola Canadensis*, a foot tall and very fragrant, grew around a tiny spring on the edge of the path, and the meadow in front of the house was covered with the more common species.

Growing in a little brook near the head of that same meadow were the tall plants of *Saxifraga micranthifolia*, and all through the woods *Zizia Bebbii* † was plentiful.

---

* *Rhododendron canescens* (Michx.), Porter (BULLETIN, XVI., 220). Holding its characters very well, the flowers with the delicious fragrance of those observed on the Pocono Plateau of Pennsylvania, and evidently a mountain plant. No *R. nudiflorum* was observed during the trip, and this is as evidently a low-ground species. I have collected *R. canescens* during the past season about High Point in the Shawangunk Mountains, both in northwestern New Jersey and southern New York.—N. L. B.

† ZIZIA BEBBII (Coult. & Rose). (*Z. aurea*, var. *Bebbii*, Coult. & Rose. Bot. Gaz., xii., 138.) This plant is very abundant all over Salt Pond Mountain, apparently to the exclusion of *Z. aurea*. The long rays of its umbels and small, rather narrow leaves appeared to be perfectly constant, and mark it as a distinct species.—N. L. B.

Along the top of one of the ridges we collected the flowers of *Hicoria alba* and *Hicoria minima*, and saw some splendid shrubs of *Cratægus coccinea* in full bloom. In the woods below the ridge *Cypripedium pubescens* and *Pogonia verticillata* were collected, but the latter was scarce.

Early on the 3d of June we drove to the Cascades of Little Stony Creek, five miles away, along a beautiful wood road, where the flora was practically the same as around Mountain Lake, and our destination was reached without any more exciting incidents than occasionally having to alight and join in clearing the road of fallen trees and decayed logs. The last mile was on foot over a rough trail, through the deep woods along the foaming water. On a tall cliff we found some unusually large fronds of *Asplenium montanum*, and on the edge of the Hemlock woods both *Asarum Canadense* and *Asarum Virginicum*. We lunched on a big rock in the centre of the stream below the very pretty falls, collected some ferns and *Cornus alternifolia*, returned to the wagons and drove down over a fearfully rough road to Eggleston's, which we reached late in the afternoon, much the worse for wear. The most important plants found on the return trip were *Phlox ovata* and three *Scutellarias*, *S. saxatilis*, *S. serrata* and *S. nervosa*.

The hotel at Eggleston's, a dreary rambling old Colonial structure, is the remains of what once must have been a fine Virginia mansion with farm-buildings and negro-quarters attached, all in a sadly dilapidated condition.

It was too late to do any botanizing that day, and we had to content ourselves with a hasty scramble over the rocks on the opposite side of the river, where we found *Draba ramosissima*, *Anemone acuta*, the fruit of *Heuchera villosa*, and on the river-bank we collected *Barbarea vulgaris*, var. *arcuata* and *Oxalis stricta*.*

---

* *Oxalis stricta*, L. (*O. corniculata*, var. *stricta*, *Savi*). In my view this is better regarded as a species than as a variety of the tropical *O. corniculata*, which is only known in the United States from the Gulf region, the lower Mississippi Valley and the southwest, while *O. stricta* extends northward far into

We were rather dismayed the next morning by the thick, white fog on the river. It cleared off by breakfast-time, but left everything drenched and the air close and hot, and hot was a mild word to apply to our climb to the top of the tall, picturesque cliffs that rise out of the river half a mile below the house. From the top we had a splendid view of the swift, opaque, red river stretching away to the right in endless rapids, the opposite banks clothed in the delicate spring foliage, the blue hills beyond, and over all the white, dancing heat of an almost tropical day. The objective point of the climb was the rare *Pachystima Canbyi*, which grows in a few spare patches on the topmost ledges. We were able to find a few of its tiny flowers, but saw no sign of any fruit.

Rhus aromatica and *Berberis Canadensis* grow on the edge of the dizzy height, and so do any number of ferns, the most notable of which were *Pellæa atropurpurea*, *Asplenium parvulum* and *Camptosorus rhizophyllus*.

Clematis Viorna was in full bloom, and so was also the pretty, delicate *Arenaria stricta*.*

After a dinner which was in every way in accord with our surroundings, we left for the station on the opposite bank of

---

Canada, being most abundant, indeed, in temperate regions, and not plenty in the regions where *O. corniculata* is most abundant. It is only depauperate plants of *O. stricta* that can be confused with *O. corniculata*. In Germany, where *O. stricta* is introduced as a weed, it is regarded as distinct from the other species. (Reichenb. Icon. Fl. Germ. & Helv., Fig. 4895; Koch, Syn. Flor. Germ. & Helv., Ed. 2, 157.)—N. L. B.

* *Arenaria stricta*, Michx. Fl. Bor. Amer. i., 274 (1803), not S. Wats.
Alsine Michauxii, Fenzl. Ann. Mus. Wien. i., 18 (1836).
Arenaria Michauxii, Hook. f. Arctic Pl., 287 (1860).

Arenaria stricta, S. Wats., Bibliog. Index, Polypet. 98 (1878), is based on *Spergula stricta*, Sw. Act. Holm., xx., 229 (1799), which is also *Alsine stricta*, Wahl. Fl. Lap., 127 (1812), and the oldest name available for it appears to be *Arenaria uliginosa*, Schleich. Dr. Watson's binomial of 1878 can in no way displace Michaux' of 1803. To be sure, Swartz' specific name *stricta*, applied to the arctic plant under *Spergula*, has priority over Michaux' *stricta* applied to the species now under consideration as *Arenaria*. This is an instance where Dr. Watson maintained an original specific name under what appears to me an erroneous principle.—N. L. B.

the river, and there were greeted with the information that our train was three and a half hours late. Three hours and a half is a mere trifle of detention in that region, so we foraged for supper in the neighboring cabins and provision stores, and the most self-sacrificing member of the party walked half a mile along the railroad track to the only spring in the place, and brought back drinking-water in a tin botany box. When the train arrived, we had a delightfully cool ride to Radford, where we spent the night in the new and pretty Queen Anne inn.

The next day, June 5th, we returned to Roanoke, and drove up and down both sides of the river in search of more *Clematis Addisonii.* We procured a big bundle of roots and a lot of fine herbarium specimens in addition to those previously collected, and among other plants not seen on our first visit we found *Gonolobus Carolinensis*, and two *Ruellias*—*Ruellia strepens* and *Ruellia ciliosa*, var. *ambigua*. *Dianthera Americana* was also in flower in the mud on the edge of the water, and on the cliffs we collected the rare *Cheilanthes vestita.*

In the evening we left for Natural Bridge, and then came a long drive on the top of the tally-ho to the hotel. We flew along through deliciously fragrant pine woods, lit up by myriads of gay, little fireflies, with here and there glimpses of the James River shining out of the darkness of the valley below. It had rained heavily during the day, and ditches and brooks were brimming full, and the stars and fireflies were reflected in them, in the most bewildering way.

The next day was so hot and close that a lengthened stay at Natural Bridge was abandoned. We spent the morning attending to our plants (which by that time was no light task) and walked to the wonderful Bridge and the great *Arbor Vitæ* in Cedar Creek ravine. The park there is a preserve, so we could do no collecting, though beyond some unusually large specimens of *Camptosorus rhizophyllus* we did not see much that we coveted.

We retraced our steps at noon to Buchanan on the James

River, and from there started on our long drive over the mountain to the Peaks of Otter.

Castanea pumila was in bloom along the base of the mountains. So was *Spiræa Aruncus* higher up, the latter a most beautiful and ornamental plant. *Œnothera glauca* and *Coreopsis verticillata* grew together under some sturdy *Pinus Virginiana*, and an interesting find was *Hieracium Marianum*, var. *spathulatum*,* hitherto only reported from Two-top Mountain, Penn.

Galium latifolium was in bloom along the road, the upper woods were filled with the pretty, slender *Galax aphylla*, and all about us were dense forests of splendid trees. A bewildering succession of fine Oaks and Chestnuts, with here and there a dark stately Hemlock, an occasional *Magnolia acuminata* and slender bud-covered *Oxydendrum arboreum*.

At the top of what our driver called "The Pass," we came upon a swamp filled with *Kalmia latifolia* in full bloom, a miniature forest of dark, glossy-leaved shrubs, covered with great pink and white clusters of flowers. In that same swamp the tall, graceful *Amianthium muscætoxicum* towered high above its smaller companions, among which we gathered some very large-leaved *Anemone trifolia*, *Parthenium integrifolium*, and the fruit of the ever-present *Dioscorea villosa*. One of the last plants gathered that day was a new variety of *Senecio aureus*. †

---

* *Hieracium Marianum*. var. *spathulatum* (Sch. Bip), A. Gray. Syn. Flor. Gamopet. Suppl. Determined by Dr. Porter.—N. L. B.

† *Senecio aureus*, L., var. *angustifolius*, n. var. Growing in dense clumps a foot or two in diameter, on dry hillsides. Stems erect, slender, 18′–2° high, simple, their bases and nodes densely clothed with long, white wool; lower leaves linear or linear-oblong, long-petioled, the blades 3′–4′ long, 6″–8″ wide, blunt at the apex, dentate all around, commonly with a few linear lobes at the base, the petioles slender, 3′–5′ long, densely woolly below; upper leaves sessile, linear, pinnatifid; heads numerous, 3″–4″ high, many-flowered, rays 6–8; akenes very hispidulous.

Evidently nearest to var. *Balsamitæ*, but different from any state of that plant (which may be a species) that has come under my observation. A specimen collected at Chapel Hill, N. C., by Prof. J. A. Holmes, in 1886, is probably to be referred here, although the wool of the base and nodes is much less.—N. L. B.

The drive was a succession of beautifu views, and at seven P. M. we were at the foot of the Peaks, and there, to our consternation, we heard that a long, steep climb was to be the end of our journey that evening. The wagons were left at a small log hut, dignified by its owner with the title of stable; and laden with the necessary bags and the precious botany boxes, we started into the dark woods up a seemingly endless and perpendicular path. We stumbled along in the pitch darkness, till an old negro with a lantern came to our rescue and piloted us over the huge boulders that crowned the summit, to the log cabin that was to be our shelter that night. How our leader, carrying two bags and two botany boxes, ever got over those boulders alone and in the dark, without breaking his neck, was a mystery we could not solve when we saw the place by daylight.

Before retiring to our primitive rooms under the roof we were shown the sights. They were the lights of many towns and villages shining up out of the valleys below, and a flock of ghostly, wild, white Angora goats that frequent the summit after nightfall.

At five we were out for sunrise, and from the lee side of a big boulder watched the light come up from behind a great bank of dark clouds and gradually brighten, first the forest-clad mountain-tops, and then creep down into the misty valleys at our feet. It was a surprisingly beautiful panorama. On one side the undulating Virginia plain, and on the other, endless chains of misty blue mountain-ranges fading into the horizon.

But even the most enthusiastic of sight-seers tire on a cold rock at five A. M., and without looking at a plant we returned to the cabin, to wait for the sun to warm things up a little.

Among the stones on the summit we found the rare *Diclytra eximia* and plenty of the beautiful, rose-colored *Rhododendron Catawbiense* in full bloom, and also collected a few fine specimens of the showy white flowers of *Pyrus Americana*. After breakfast we climbed down over the pathless ledge into the woods below, where we found *Lilium Grayi* and *Melan-*

thium parviflorum in bud, and some astonishingly large and beautiful flowers of *Aquilegia Canadensis*. *Asarum arifolium* was flowering below the summit near a little spring, and the top of a group of huge boulders called The Needles was covered with the pretty *Paronychia argyrocoma*.

We collected some fine fruiting specimens of *Clematis verticillata*, and also found the fruit of many plants seen in flower ten days earlier on Salt Pond Mountain, and at noon we walked down to the stable, where we sat in the hay and put our plants into press.

Buchanan was reached on the return trip in time to collect our hand-luggage (which by that time, counting bags, botany boxes, plant presses, bundles of roots tied up in red bandannas, etc., for a party of seven, amounted to twenty-two pieces), and catch the Shenandoah Valley train that evening.

The next stop was at Luray, where the caves were visited, and we took a drive across the valley, but beyond the plants already mentioned as found there, we did not see anything very remarkable. Our steps were then turned homewards, and New York was reached at noon on June 10th. We had been away fifteen days and collected about 1,000 specimens, representing 71 orders, 195 genera and 215 species, as enumerated in the following list. A delightful trip, and one which I am sure we all hope may be repeated.

VIRGINIAN PLANTS.

Collected by Hon. Addison Brown, Thos. Hogg, Anna Murray Vail, Millie Timmerman and Dr. and Mrs. N. L. Britton.
May 30th–June 9th, 1890.

Clematis Addisonii, Britt. Roanoke.

Clematis viornioides, Britt. (*C. Addisonii* x *C. Viorna*). Roanoke.

Clematis Viorna, L. Roanoke, Eggleston's.

Clematis verticillaris, D. C. Peaks of Otter.

Anemone Virginiana, L. Roanoke.

Anemone quinquefolia, L. Salt Pond Mountain.

Anemone trifolia, L. Salt Pond Mountain, Peaks of Otter.

Anemone Hepatica, L. Eggleston's.

ANEMONE ACUTA (Pursh). (*Hepatica triloba*, var. *acuta*, Pursh, Fl. Am., Sept., 391 (1814), *Hep. acutiloba*, D. C. Prod. i., 22 (1824).

Thalictrum dioicum, L. Salt Pond Mountain.

Thalictrum purpurascens, L. Roanoke.

TRAUTVETTERIA CAROLINIENSIS (Walter), *Hydrastis Caroliniensis*, Walt. Fl. Car., 156 (1788), *Cimicifuga palmata*, Michx. Fl. Bor. Am., i., 316 (1803) ; *Traut. palmata*, Fish. & Mey.) Salt Pond Mountain.

Ranunculus abortivus, L. Salt Pond Mountain.

Ranunculus sceleratus, L. Roanoke.

Ranunculus recurvatus, L. Salt Pond Mountain.

Ranunculus septentrionalis, Poir. Salt Pond Mountain.

Aquilegia Canadensis, L. Roanoke, Salt Pond Mountain, Peaks of Otter.

Delphinium Consolida, L. Roanoke.

Aconitum uncinatum, L. Peaks of Otter.

Actea alba (L.), Bigelow. Salt Pond Mountain.

Magnolia acuminata, L. Salt Pond Mountain, Peaks of Otter.

Asimina triloba (L.), Dunal. Roanoke.

Berberis Canadensis (Ait.), Pursh. Eggleston's Cliffs.

Caulophyllum thalictroides (L.), Michx. Salt Pond Mountain.

Podophyllum peltatum, L. Salt Pond Mountain.

Chelidonium majus, L. Salt Pond Mountain.

Diclytra eximia (Ker.), D. C. Peaks of Otter.

Corydalis flavula, D. C. Salt Pond Mountain.

Corydalis micrantha (Engelm.), Gray. Roanoke.

Arabis Canadensis, L. Salt Pond Mountain, Peaks of Otter.

Arabis lyrata, L. Eggleston's.

Drabd ramosissima, Desv. Eggleston's.

Nasturtium officinale, R. Br. Roanoke.

Barbarea vulgaris, R. Br., var. *arcuata* (Reich), Koch. Eggleston's.

Lepidium Virginicum, L. Eggleston's.

Viola pedata, L. Salt Pond Mountain, Peaks of Otter.

Viola pedata, L., forma *bicolor* (Pursh), Britt. Salt Pond Mountain.

Viola palmata, L. Eggleston's.

Viola obliqua, Hill. Eggleston's, Salt Pond Mountain.

Viola obliqua, Hill, forma *alba* (T. & G.) Salt Pond Mountain.

Viola sagittata, Ait. Salt Pond Mountain.

Viola blanda, Willd. Salt Pond Mountain.

Viola rotundifolia, Michx. Salt Pond Mountain.

Viola pubescens, Ait. Salt Pond Mountain.

Viola hastata, Michx. Salt Pond Mountain.

Viola Canadensis, L. Salt Pond Mountain.

Viola striata, Ait. Salt Pond Mountain.

Dianthus Armeria, L. Eggleston's.

Silene Virginica, L. Roanoke, Salt Pond Mountain, Peaks of Otter.

Silene antirrhina, L. Roanoke.

Arenaria serpyllifolia, L. Radford.

Arenaria stricta, Michx. Eggleston's.

Stellaria pubera, Michx. Salt Pond Mountain.

Hypericum prolificum, L. Roanoke.

Tilia heterophylla, Vent. Salt Pond Mountain.

Geranium maculatum, L. Salt Pond Mountain.

Oxalis Acetosella, L. Salt Pond Mountain.

Oxalis violacea, L. Salt Pond Mountain.

Oxalis stricta, L. Eggleston's.

Oxalis recurva, Ell. Roanoke, Eggleston's.

Ilex montana, A. Gray. Salt Pond Mountain, Peaks of Otter.

Celastrus scandens, L. Peaks of Otter.

Euonymus atropurpureus, Jacq. Roanoke.

Pachystima Canbyi, A. Gray. Eggleston's Cliffs.

Ceanothus Americanus, L. Peaks of Otter, Luray.

Vitis æstivalis, Michx. Peaks of Otter.

Æsculus lutea, Wang. Schrift. Nat. Fr. Berlin, viii., 133 (1788). *Æ. octandra*, Marsh. Arb. Amer., 4 (1785), not Mill (1768). *Æ. flava*, Ait. Hort. Kew, i., 494 (1789). Salt Pond Mountain.

Acer Pennsylvanicum, L. Salt Pond Mountain.

Acer spicatum, Lam. Salt Pond Mountain.

Rhus aromatica, Ait. Eggleston's Cliffs.

Polygala Senega, L. Salt Pond Mountain.

Baptisia tinctoria (L.), R. Br. Salt Pond Mountain, Peaks of Otter.

Lupinus perennis, L. Peaks of Otter.

Trifolium arvense, L. Roanoke.

Trifolium procumbens, L. Roanoke.

Tephrosia Virginiana (L.), Pers. Roanoke, Peaks of Otter.

Robinia Pseudacacia, L. Peaks of Otter.

Lespedeza violacea (L.), Pers. Roanoke.

Stylosanthes biflora (L.), B. S. P. Peaks of Otter.

Vicia Americana, Muhl. Peaks of Otter.

Lathyrus venosus, Muhl. Peaks of Otter.

Prunus serotina, Ehrh. Salt Pond Mountain.

Prunus Virginiana, L. Peaks of Otter.

Spiræa corymbosa, Raf. Peaks of Otter.

Spiræa Aruncus, L. Peaks of Otter.

Physocarpa opulifolia (L.), Raf. Peaks of Otter.

Gillenia trifoliata (L.), Moench. Salt Pond Mountain.

Rubus odoratus, L. Peaks of Otter.
Potentilla Canadensis, L. Salt Pond Mountain.
Rosa humilis, Marsh. Roanoke.
Pyrus nigra (Marsh.), Sargent. Salt Pond Mountain.
Pyrus Americana, (Marsh.), D. C. Peaks of Otter.
Cratægus coccinea, L. Salt Pond Mountain.
Cratægus punctata, Jacq. Roanoke.
Cratægus Crus-galli, L. Roanoke.
Amelanchier Canadensis, var. *rotundifolia*, T. & Gr. Salt Lake Mountain.
Saxifraga Virginiensis, L. Peaks of Otter.
Saxifraga micranthifolia (Haw.), B. S. P. Salt Pond Mountain.
Saxifraga leucanthemifolia, Michx. Salt Pond Mountain.
Tiarella cordifolia, L. Salt Pond Mountain.
Heuchera villosa, Michx. Salt Pond Mountain, Eggleston's.
Heuchera Americana, L. Peaks of Otter.
Heuchera pubescens, Pursh. Roanoke.
Parnassia asarifolia, Vent. Salt Pond Mountain.
Ribes Cynosbati, L. Salt Pond Mountain.
Ribes rotundifolium, Michx. Salt Pond Mountain.
Sedum Nevii, Gray. Roanoke.
Sedum ternatum, Michx. Salt Pond Mountain.
Callitriche heterophylla, Pursh. Salt Pond Mountain.
Œnothera glauca, Michx. Peaks of Otter.
Thaspium barbinode (Michx.), Nutt. Peaks of Otter, Roanoke.
Pimpinella integerrima (L.), Benth. & Hook. Salt Pond Mountain.
Zizia cordata, Koch. Peaks of Otter.
Zizia Bebbii (Coult. & Rose), Britt. Salt Pond Mountain.
Osmorhiza longistylis, (Torr.), D. C. Salt Pond Mountain, Roanoke.
Sanicula Marylandica, L. Salt Pond Mountain.
Aralia nudicaulis, L. Salt Pond Mountain.
Cornus florida, L. Peaks of Otter.
Cornus alternifolia, L. f. Salt Pond Mountain (Cascade).

Viburnum lantanoides, Michx. Salt Pond Mountain.
Viburnum nudum, L. Salt Pond Mountain.
Diervilla trifida, Mœnch. Peaks of Otter.
Triosteum perfoliatum, L. Peaks of Otter.
Houstonia cærulea, L. Salt Pond Mountain.
Houstonia purpurea, L., var. *longifolia* (Gaertn.), A. Gray. Peaks of Otter, Salt Pond Mountain.
Mitchella repens, L. Salt Pond Mountain, Natural Bridge.
Galium latifolium, Michx. Eggleston's, Peaks of Otter.
Galium circæzans, Michx. Eggleston's.
Erigeron bellidifolius, Muhl. Salt Pond Mountain.
Erigeron Philadelphicus, L. Eggleston's.
Filago Germanica, L. Luray.
Antennaria plantaginifolia (L.), Hook. Salt Pond Mountain.
Gnaphalium pnrpureum, L. Roanoke.
Parthenium integrifolium, L. Peaks of Otter.
Rudbeckia triloba, L. Eggleston's.
Coreopsis verticillata, L. Peaks of Otter.
Senecio aureus, L. Culpeper.
Senecio aureus, var. *Balsamitæ*. (Muhl.), Torr. & Gr. Peaks of Otter.
Senecio aureus, L., var. *angustifolius*, Britt. Peaks of Otter.
Hieracium venosum, L. Salt Pond Mountain, Roanoke.
Hieracium Marianum, Willd., var. *spathulatum* (Sch. Bip.), A. Gray. Peaks of Otter.
Crepis pulchra, L. Near Culpeper—railroad embankment.
Lobelia spicata, L. Luray.
Gaylussacia resinosa (Ait.), Torr. & Gray. Luray, Salt Pond Mountain.
Vaccinium stamineum, L. Salt Pond Mountain.
Vaccinium Pennsylvanicum, Lam. Salt Pond Mountain.
Vaccinium vacillans, Solander. Salt Pond Mountain.
Vaccinium corymbosum, L. Salt Pond Mountain.
Vaccinium erythrocarpon, Michx. Salt Pond Mountain.
Oxycoccus macrocarpus (Ait.), Pers. Salt Pond Mountain.
Epigæa repens, L. Salt Pond Mountain.

Andromeda ligustrina, Muhl. Salt Pond Mountain, Peaks of Otter.

Andromeda ligustrina, Muhl, var. *pubescens*, A. Gray. Salt Pond Mountain.

Oxydendrum arboreum (L.), D. C. Eggleston's, Peaks of Otter.

Kalmia latifolia, L. Salt Pond Mountain, Peaks of Otter.

Menziesia globularis, Salisb. Salt Pond Mountain.

Rhododendron canescens (Michx.), Porter. Salt Pond Mountain, Peaks of Otter.

Rhododendron calendulaceum (Michx.), Torr. Salt Pond Mountain.

Rhododendron Catawbiense, Michx. Peaks of Otter.

Chimaphila maculata (L.), Pursh. Peaks of Otter.

Galax aphylla, L. Salt Pond Mountain, Peaks of Otter.

Lysimachia quadrifolia, L. Peaks of Otter.

Samolus Valerandi, L., var. *floribundus* (H. B. K.), B. S. P. Salt Pond Mountain.

Diospyros Virginiana, L. Roanoke.

Apocynum androsæmifolium, L.

Apocynum cannabinum, L. Salt Pond Mountain.

Asclepias purpurascens, L. Roanoke.

Asclepias variegata, L. Eggleston's, Peaks of Otter.

Asclepias quadrifolia, L. Salt Pond Mountain, Peaks of Otter.

Gonolobus Carolinensis (Jacq.), R. Br. Roanoke.

Phlox ovata, L. Near Eggleston's.

Phlox divaricata, L. Salt Pond Mountain.

Hydrophyllum Virginicum, L. Salt Pond Mountain.

Phacelia parviflora, Pursh. Salt Pond Mountain.

Cynoglossum officinale, L. Salt Pond Mountain.

Cynoglossum Virginicum, L. Roanoke.

Myosotis laxa, Lehm. Peaks of Otter, near Buchanan.

Onosmodium Virginicum (L.), D. C. Peaks of Otter.

Onosmodium Carolinianum (Lam.), D. C. Roanoke.

Echium vulgare, L. Buenavista.

Convolvulus spithamæus, L. Peaks of Otter.

Linaria vulgaris, Mill. Luray.

Scrophularia nodosa, L., var. *Marylandica* (L.), A. Gray. Peaks of Otter.

Pentstemon hirsutus (L.), Willd.

Pentstemon lævigatus, Sol. Roanoke.

Pentstemon lævigatus, Sol., var. *canescens*, Britt. Peaks of Otter, Roanoke, Luray.

Veronica Anagallis, L. Roanoke.

Veronica officinalis, L. Radford.

Veronica serpyllifolia, L. Mountain Lake.

Veronica arvensis, L. Radford.

Castilleia coccinea (L.), Spreng. Salt Pond Mountain.

Pedicularis Canadensis, L. Salt Pond Mountain.

Epiphegus Virginiana (L.), Bart. Salt Pond Mountain.

Conopholis Americana (L. f.), Wallr. Salt Pond Mountain.

Aphyllon uniflorum (L.), A. Gray. Salt Pond Mountain.

Ruellia ciliosa, Pursh, var. *ambigua*, A. Gray. Roanoke.

Ruellia strepens, L. Roanoke.

Dianthera Americana, L. Roanoke.

Verbena angustifolia, Michx. Roanoke, Luray.

Salvia lyrata, L. Roanoke.

Monarda fistulosa, L. Roanoke.

Scutellaria saxatilis, Riddell. Salt Pond Mountain.

Scutellaria serrata, Andrews. Salt Pond Mountain.

Scutellaria pilosa, Michx. Luray.

Scutellaria nervosa, Pursh. Salt Pond Mountain.

Marrubium vulgare, L. Roanoke.

Leonurus Cardiaca, L. Eggleston's.

Paronychia argyrocoma, Nutt. Peaks of Otter.

Polygonum terrestre (Michx.), Britt. Eggleston's.

Polygonum Convolvulus, L. Natural Bridge.

Asarum Canadense, L. Salt Pond Mountain.

Asarum Virginicum, L. Salt Pond Mountain (Cascade).

Asarum arifolium, Michx. Peaks of Otter.

Aristolochia Sipho, L'Her. Salt Pond Mountain.

Euphorbia corollata, L. Roanoke, Peaks of Otter, Luray.

Euphorbia commutata, Engelm. Roanoke.

Euphorbia Lathyris, L. Luray.

Laportea Canadensis (L.), Gaud. Salt Pond Mountain.

Hicoria alba (L.), Britt. Salt Pond Mountain.

Hicoria minima (Marsh.), Britt. Salt Pond Mountain.

Alnus viridis, D. C. Salt Pond Mountain.

Quercus alba, L. Salt Pond Mountain.

Quercus ilicifolia, Wang. Salt Pond Mountain.

Castanea pumila, Mill. Peaks of Otter.

Pinus Strobus, L. Salt Pond Mountain.

Liparis liliifolia (L.), Richard. Eggleston's.

Goodyera repens (L.), R. Br. Salt Pond Mountain.

Pogonia verticillata (Willd.), Nutt. Salt Pond Mountain.

Habenaria bracteata (Willd.), R. Br. Salt Pond Mountain.

Cypripedium parviflorum, Salisb. Salt Pond Mountain, Peaks of Otter.

Cypripedium pubescens, Willd. Salt Pond Mountain.

Cypripedium acaule, Ait. Salt Pond Mountain, Peaks of Otter.

Sisyrinchium angustifolium, Mill. Salt Pond Mountain, Eggleston's.

Hypoxis erecta, L. Salt Pond Mountain, Eggleston's.

Dioscorea villosa, L. Salt Pond Mountain.

Smilax Walteri, Pursh. Eggleston's.

Smilax rotundifolia, L. Salt Pond Mountain.

Smilax Pseudo-China, L. Roanoke.

Convallaria majalis, L. Salt Pond Mountain, Peaks of Otter.

Polygonatum commutatum, (Schult), Dietr. Salt Pond Mountain.

Unifolium Canadense (Desf.), Greene. Salt Pond Mountain.

Unifolium racemosum (L.) Britt. Salt Pond Mountain.

Disporum lanuginosum (Michx.), Britt. Salt Pond Mountain.

Clintonia borealis (Ait.), Raf. Salt Pond Mountain.

Clintonia umbellata (Poir.), Torr. Salt Pond Mountain.

Uvularia perfoliata, L. Salt Pond Mountain.

Uvularia puberula, Michx. Salt Pond Mountain.

Lilium Grayi, S. Wats. Salt Pond Mountain, Peaks of Otter.
Medeola Virginiana, L. Salt Pond Mountain, Peaks of Otter.
Trillium erectum, L. Salt Pond Mountain.
Trillium grandiflorum, Salisb. Salt Pond Mountain.
Trillium erythrocarpum, Michx. Salt Pond Mountain.
Chamælirium luteum (L.), A. Gray. Salt Pond Mountain.
Melanthium parviflorum (Michx.), S. Wats. Salt Pond Mountain, Peaks of Otter.
Veratrum viride, Ait. Salt Pond Mountain.
Amianthium muscætoxicum (Walt.), A. Gray. Peaks of Otter.
Tradescantia Virginica, L. Salt Pond Mountain.
Luzula campestris (L.), D. C. Salt Pond Mountain.
Arisæma triphyllum (L.), Torr. Salt Pond Mountain.
Carex intumescens, Rudge. Salt Pond Mountain.
Carex lurida, Wahl., var. *gracilis*, Boott. Salt Pond Mountain.
Carex scabrata, Schw. Salt Pond Mountain, Peaks of Otter.
Carex prasina, Wahl. Salt Pond Mountain.
Carex gynandra, Schw. Salt Pond Mountain, Peaks of Otter.
Carex æstivalis, Curtis. Peaks of Otter.
Carex laxiflora, Lam., var. *latifolia*, Boott. Salt Pond Mountain.
Carex platyphylla, Carey. Eggleston's.
Carex communis, Bailey. Peaks of Otter.
Carex polytrichoides, Muhl. Salt Pond Mountain.
Carex stipata, Muhl. Salt Pond Mountain.
Carex rosea, Schk. Salt Pond Mountain.
Carex rosea, Schk., var. *radiata*, Dewey. Peaks of Otter.
Carex canescens, L. Salt Pond Mountain.
Carex canescens, L., var. *brunescens* (Pers.), Boott. Salt Pond Mountain.
Carex echinata, Murray. Salt Pond Mountain.
Carex adusta, Boott. Peaks of Otter.
Carex scoparia, Schk. Peaks of Otter.
Carex cephalophora, Schk. Eggleston's.
Panicum latifolium, L., var. *molle*, Vasey. Salt Pond Mountain.

Panicum clandestinum, L. Salt Pond Mountain, Peaks of Otter.

Panicum depauperatum, Muhl. Salt Pond Mountain.

Arrhenatherum elatius (L.), Mert. & Koch. Roanoke.

Holcus lanatus, L. Luray.

Trisetum Pennsylvanicum (L.), B. S. P. Peaks of Otter.

Danthonia spicata (L.), Beauv. Peaks of Otter.

Eatonia Dudleyi, Vasey. Salt Pond Mountain, Eggleston's.

Melica diffusa, Pursh. Roanoke.

Poa brevifolia, Muhl. Salt Pond Mountain.

Glyceria elongata (Torr.), Trin. Peaks of Otter.

Glyceria nervata (Willd.), Trin. Salt Pond Mountain.

Festuca nutans, Spreng. Salt Pond Mountain, Eggleston's.

Festuca elatior, L. Roanoke.

Bromus racemosus, L. Long Bridge, Alexandria.

Bromus purgans, L. Eggleston's.

Equisetum hyemale, L. Roanoke River.

Cheilanthes vestita, Swartz. Banks of Roanoke River.

Pellæa atropurpurea (L.), Link. Roanoke, Eggleston's.

Asplenium Trichomanes, L. Cascade on Salt Pond Mountain.

Asplenium parvulum, Mart. & Gal. Eggleston's Cliffs, Roanoke Cliffs.

Asplenium platyneuron (L.), Oakes. Salt Pond Mountain.

Asplenium montanum, Willd. Salt Pond Mountain, Peaks of Otter.

Asplenium Ruta-muraria, L. Eggleston's, Roanoke.

Camptosorus rhizophyllus (L.), Link. Salt Pond Mountain, Eggleston's, Natural Bridge.

Aspidium spinulosum, Swartz, var. *dilatatum*, Hook. Salt Pond Mountain.

Aspidium acrostichoides (Michx.), Sw. Salt Pond Mountain.

Cystopteris bulbifera (L.), Bernh. Salt Pond Mountain.

Woodsia obtusa (Spreng.), Torr. Roanoke.

Osmunda Claytoniana, L. Salt Pond Mountain.

Botrychium Virginianum (L.), Swartz. Peaks of Otter.

Lycopodium lucidulum, Michx. Salt Pond Mountain.

Lycopodium obscurum, L. Salt Pond Mountain.

LIST OF THE MOSSES COLLECTED.

By Elizabeth G. Britton.

The mosses collected were not many nor of special interest, with one exception. At the spring on the Peaks of Otter, on the vertical face of shaded rock, was collected a sterile *Grimmia*, which on examination proves to be *G. Hartmanni*, a species new to the United States, since the specimens collected by Mr. Leiberg prove not to be that species ; associated with it was *Swartzia montana*, also sterile. The following is the list of species :

Bartramia pomiformis, Hedw. Cascades, Little Stony Creek.

Dicranum scoparium (L.), Hedw. Mountain Lake.

D. montanum, Hedw. Little Stony Creek.

Swartzia montana (Lamk.), Lindb. Peaks of Otter.

Fissidens subbasilaris, Hedw. Roanoke River, Mountain Lake

Georgia pellucida (L.), Rab. Bald Knob, Cascades of Little Stony Creek.

Webera sessilis (Schmid.), Lindb. (*Diphyscium foliosum*, W. & M.) Peaks of Otter.

Mollia æruginosa (Sm.), Lindb. (*Gymnostomum rupestre*, Schwægr.) Cascades.

Polytrichum formosum, Hedw. Salt Pond Mountain.

Grimmia campestris, Burchell (*G. leucophæa*, Grev.) Peaks of Otter.

Grimmia Hartmanni, Br. & Sch. At the spring, Peaks of Otter.

Weissia Americana (P. Beauv.), Lindb. (*Ulota Hutchinsiæ*, Schimp.) Bald Knob.

W. ulophylla, Ehrh. (*U. crispa*, Brid.) Bald Knob, Peaks of Otter.

Drummondia clavellata, Hook. Bald Knob, Peaks of Otter.

Bryum bimum, Schreb. Mountain Lake.

B. roseum, Schreb. Mountain Lake, Peaks of Otter.

Pohlia nutans (Schreb.), Lindb. (*Webera nutans*, Hedw.) Cascades, Peaks of Otter.

P. elongata, Hedw. (*W. elongata*, Schwægr.) Mountain Lake, Cascades.

Mnium cuspidatum, Hedw. Mountain Lake.

M. punctatum (L.), Hedw. Mountain Lake.

Fontinalis Dalecarlica, Br. & Sch. Mountain Lake, Cascades of Stony Creek.

Anomodon obtusifolius, Br. & Sch. Roanoke.

Climacium Americanum, Brid. Mountain Lake.

C. dendroides, Web. & Mohr. Bald Knob, Salt Pond Mountain.

Cylindrothecium cladorhizans, Schimp. Peaks of Otter.

Leucodon brachypus, Brid. Roanoke, Mountain Lake, Peaks of Otter.

Neckera pennata, Hedw. Mountain Lake.

Thuidium abietinum (L.), Br. Eu. Bald Knob, Salt Pond Mountain.

Brachythecium salebrosum, Hoffm. Little Stony Creek, Mountain Lake.

Plagiothecium Muhlenbeckii, Spruce. Bald Knob, Cascades of Little Stony Creek.

P. denticulatum, L. Cascades of Little Stony Creek.

Hypnum curvifolium, Hedw. Little Stony Creek, Mountain Lake.

H. imponens, Hedw. Little Stony Creek, Mountain Lake.

H. cupressiforme, L. Little Stony Creek, Mountain Lake.
var. *filiforme*, Brid. Bald Knob, Salt Pond Mountain.

Amblystegium radicale, Beauv. Little Stony Creek, Mountain Lake.

Campylium chrysophyllum, Brid. Mountain Lake, Cascades of Little Stony Creek.

Rhytidium rugosum (L.) Bald Knob, Mountain Lake, Peaks of Otter.

Hylocomium parietinum (L.), Lindb. (*H. Schreberi*, Willd.) Bald Knob.

H. brevirostre, Br. & Sch. Bald Knob, sterile. Cascades, fruiting.

Hypnum stramineum, Dicks. With *Dicranum*, on logs in Mountain Lake.

ON THE AUTUMN FLORA OF SOUTH-EASTERN VIRGINIA.

By Arthur Hollick.

During the month of September Dr. N. L. Britton proposed that we should make a trip to Southeastern Virginia, in order to study the autumn flora of that region, and with that end in view we made Norfolk our headquarters. We arrived at Norfolk September 25th, and immediately commenced collecting. A branch of the Elizabeth River extends well up into the city, and along these banks were found a large number of the representative plants of the region. *Solidago Canadensis*, var. *procera*, *S. Caroliniana*, *Eupatorium serotinum*, *E. perfoliatum*, *Baccharis halimifolia* and *Verbesina Sigesbeckii* made up the bulk of the vegetation. *Smilax Bona-nox* was plentiful, and was the prevailing species. *Quercus Phellos* was common, and seemed a favorite tree for roadside planting in the city. Early on the morning of the 26th we started for Virginia Beach, a portion of the coast near the mouth of Chesapeake Bay. Here we obtained an excellent idea of the coast flora and added two new plants to the known flora of Virginia, viz.: *Eleocharis ochreata* and *Panicum gibbum*. In the sandy swamps and along the borders of ponds, immediately back of the beach, were *Ilex opaca*, the size of forest trees, and with it were *I. vomitoria* and *I. Cassine*. *Vitis rotundifolia* was found clambering everywhere over the bushes. Locally this grape is known as "bullace grape," and even in its primitive state it is not unpalatable when perfectly ripe. This is the species from which the "Scuppernong" is said to have been derived,—a variety much used for the table,—as we ascertained at Norfolk, where they were served regularly three times a

day. *Hydrocotyle umbellata* and *H. Asiatica* were plentiful in the wet sand. The genus *Eupatorium* was well represented; for in addition to the species collected the previous day at Norfolk we found *E. rotundifolium*, *E. hyssopifolium*, *E. cœlestinum*, with its showy blue corymbs, and *E. fœniculoides*, which was one of the most conspicuous objects in the landscape in places. Whole fields seemed to be in its possession, and the long feathery panicles were singularly graceful in appearance. Trailing over the ground and bushes, and climbing high in trees, we were surprised to find *Gelsemium sempervirens* in full flower and with many buds partly opened, although the time of flowering is said to be March and April. *Callicarpa Americana*, with its showy red-purple clusters of berries, was a beautiful object, rather sparingly represented. *Lechea maritima* was collected on the dry sand dunes, and *Œnothera humifusa* on the sea beach just above high-water mark. In addition to the above mentioned, about forty others were obtained, including *Rynchospora glomerata*, var. *paniculata*.

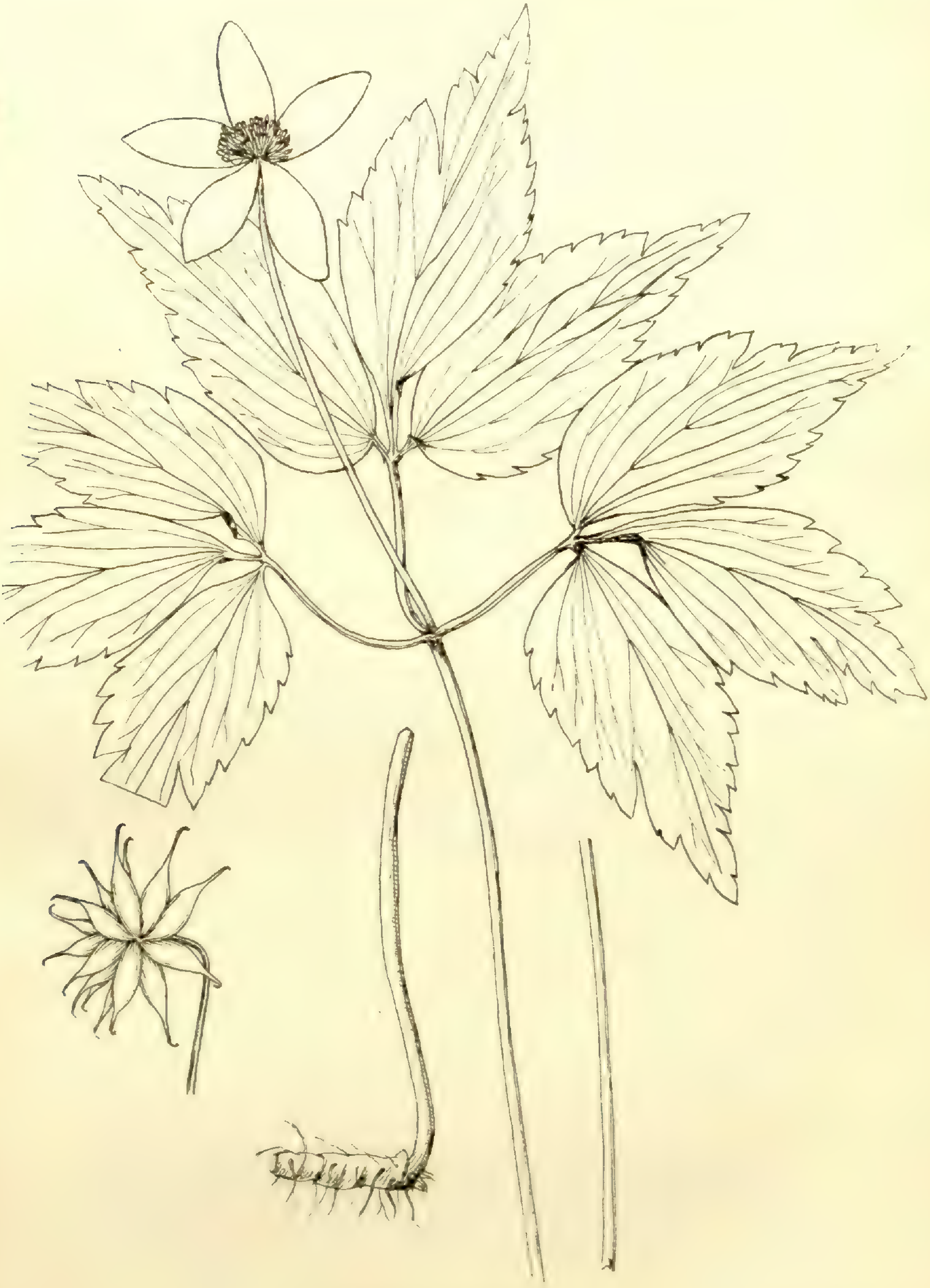
On the 27th we took the railroad to Suffolk, and from thence secured two canoes and boatmen to paddle us up the old canal into the Dismal Swamp. This canal was cut through the swamp for the purpose of floating out timber. It averages some 4 or 5 ft. deep, and about 10 ft. wide, and a journey of about six miles by this means enabled us to form an excellent idea of the vegetation. Throughout several miles there was a dense growth of "cane-brake" on each side. (*Arundinaria macrosperma*, var. *suffruticosa.*) The genus *Ilex* was represented by *I. Cassine*, *I. lævigata* and *I. glaber*. *Smilax laurifolia* was omnipresent. Less common was *S. Walteri*, specimens of which were found with light yellow berries tinged with red, for which the name forma *pallida* is proposed. I was especially interested in noting several trees of *Quercus heterophylla*, not only because this increases the range of the tree, but also on account of finding it associated as usual with *Q. Phellos* and *Q. rubra* or possibly *Q. tinctoria*, between which latter I was

in doubt on account of not finding any fruit. The only other representative of the genus present was *Q. aquatica*. *Nyssa biflora* and *N. sylvatica* were amongst the most conspicuous trees. *N. uniflora*, under the name of "poison oak," was not so common. My negro boatman warned me not to touch this tree on account of its poisonous properties, but as no evil effects have yet ensued from handling the specimens I do not place much faith in the legend. *Leucothoe racemosa*, *Andromeda ligustrina* and several other shrubs were collected indiscriminately, and amongst them we found, on more careful examination, *Andromeda nitida*, another addition to the flora of the region. *Gerardia purpurea*, with white flowers (forma *albiflora*), was growing on the banks of the canal. *Utricularia purpurea* was abundant in places close to the banks, and masses of *Eriophorum Virginicum* were frequent. A single specimen representing a variety of *Rynchospora axillaris* was obtained. Most all of the large trees were cut for timber many years since, and although there are a few specimens of *Taxodium distichum*, they are only of small second growth, with "knees" very little developed. A peculiar delicate bell-shaped fungus frequently infests the branches of this tree, giving the young ones the appearance of ericaceous shrubs. *Nesæa verticillata*, with splendidly developed ærenchymous branches, bordered the canal for miles. On the roadside between Suffolk and the canal a dense growth of a clover-like plant attracted our attention, which turned out to be *Lespedeza striata*, a still further addition to the flora of the region. *Oxydendrum arboreum*, *Solidago puberula* and *Chrysopsis graminifolia* were also collected along the said roadside.

Our intention had been to explore the vicinity of Fortress Monroe on the 28th and 29th, but stormy weather prevented. There is but little doubt that many new and interesting finds await the botanist in this region, as indicated by the four species new to the State added in two days' collecting so late in the season, and 113 other species which we found of sufficient interest to bring back with us.

CLEMATIS ADDISONII, BRITT.

(Slightly reduced in engraving.)



ANEMONE TRIFOLIA, L.

(Plant natural size; fruit enlarged.)

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. II. No. 3.

Contributions to the Knowledge of the Germination of some North American Plants.

(With Plates V.—XIX.)

BY THEODOR HOLM.

ISSUED APRIL 15th, 1891.

PRICE, $1.00.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. II. No. 3.

CONTRIBUTIONS TO THE KNOWLEDGE OF THE GERMINATION OF SOME NORTH AMERICAN PLANTS.

BY THEODOR HOLM.

(Plates V.–XIX.)

The present paper deals with the description of the germination and early stage of the growth and development of the rhizomes of some plants, mostly from North America. The greater part of the material upon which it is based was collected in the immediate vicinity of Washington. The foreign materials, as well as some of the rarer North American species, were obtained from the U. S. Botanical Garden, where they had been cultivated by Mr. G. W. Oliver, to whom the author is under especial obligations. The author is also greatly indebted to Prof. F. H. Knowlton, who has kindly looked over the manuscript and suggested several alterations in regard to the language, and recommended the use of some botanical terms.

RANUNCULACEÆ.

Anemone thalictroides.

This plant was first described by Linné, and referred to the genus *Anemone*, and later has been transferred from one genus to another by various authors. Michaux placed it under *Thalictrum*, and Asa Gray, accepting the suggestion of Michaux in regard to its systematic position, called it *Thalictrum anemonoides*, although with the additional subgeneric name of *Syndesmon* of Hoffmansegg.

The plant was then again placed under *Anemone* by Bentham and Hooker as representing the subgenus "*Syndesmon*," considered as identical with *Anemonella* of Spach. In the 6th edition of Gray's Manual, revised by Watson and

Coulter, we find it as a true genus *Anemonella*, separate from *Anemone* and *Thalictrum*.

The plant seems to show characters intermediate between those of *Anemone* and *Thalictrum*, having the flower and involucre of an *Anemone* and the foliage of a *Thalictrum*. It has umbellate peduncles like those of *Anemone narcissiflora* and others, while the ribbed achenia ally it to *Thalictrum*; but it does not seem, however, as though this divergence of characters were sufficient to entitle it to rank as a separate genus.

And when the genus *Anemonella*, in the synopsis of the genera in the revised edition of Gray's Manual, is characterized as having a larger number of achenia than *Thalictrum*, that is, "four to fifteen in *Anemonella*," and few in *Thalictrum*, it does not correspond to what is said in the generic diagnosis of *Thalictrum*, which is also described as having "four to fifteen achenes."

In regard to the structure of the roots our plant shows a certain peculiarity, which removes it at once from *Anemone* and *Thalictrum*. The roots are fusiform and tuberous, corresponding to the same kind of nutritive roots so well known in *Dahlia*, *Ficaria*, etc. The plant is perennial and the germination shows a few points of interest. A germinating plantlet has been figured on Plate V, Fig. 1, where we see the two long-petioled cotyledons, the blades of which are ovate and almost obtuse (Fig. 2). There is no distinct hypocotyl,* but the primary root, which seems to commence immediately under the cotyledons, is strongly developed and shows a certain ability of growth in thickness in this very early state. The end of the root is sometimes bifurcated and terminates suddenly in thin branches. The first leaf shows the general features of the final ones, but has merely a smaller number of divisions. A somewhat older state is shown in Fig. 3, where the primary root shows the characteristic tuberous form, while no secondary roots are yet developed. One of these is,

---

* "Hypocotyl" has been used instead of the older term "caulicle," in accordance with Darwin's usage (The Power of Movement in Plants, 1881, p. 5), signifying the hypocotyledonous portion of the stem.

however, to be seen in Fig. 4, and shows the bifurcation mentioned above. There is to be observed a difference in regard to the roots and the foliage, if we consider the older, full-grown and flowering specimen, the rhizome and roots of which are shown in Fig. 5. The primary root is either no longer present or is not to be distinguished from the equally developed secondary roots. It is most probable that it has disappeared during the gradual growth of the plant. Another thing is the presence of a slender, thin, not at all tuberous root (r*), which proceeds from the rhizome at the very base of the stem. This part is covered with several (usually six) scale-like leaves, so that our plant has two different kinds of roots as well as of leaves. The roots are tuberous or slender and the leaves underground and scale-like or above ground and ternately compound.

Thalictrum dioicum.

Two germinating plantlets have been figured in Plate V, Figs. 6 and 7, and show the presence of a distinct primary root (R), which already forms several lateral branches in this very early stage. The hypocotyl is frequently very short, and there is a wreath of rather long root-hairs at the base, where it passes into the root. The cotyledons, which are above ground, are long-petioled, with the blade varying from ovate and acute to broadly ovate and obtuse. The first leaf after the cotyledons has mostly the same form as the leaves that develop later. It is decompound, with the divisions cordate, obcordate or roundish. The primary root is not of long persistence, and is replaced by several secondary ones, developed from the base of the stem, which can be seen on an older plant (Fig. 8).

We have there a vertical stem, bearing several leaves, of which the lowest are from the previous year and faded. The internodes are very distinct, and at the two earliest, buds have developed, so that the complete rhizome is indicated as being vertical with ascending shoots. We see this final form of the rhizome in Fig. 9, drawn from a flowering specimen, which shows the relatively short under-

ground axis, upon which a large bud has been developed at the side of the base of the stem. This bud, so much larger than the other ones, of which four are visible in the figure, situated a little higher up on the stem, alternating like the leaves, in the axils of which they have been developed—this bud will produce in the following year a series of leaves and a flowering stem. The smaller buds will merely produce leafy shoots, of which one has been shown in the same figure, but it is to be supposed that they might be of a certain importance to the plant, if, for instance, the large bud should be injured, they might then replace it and get a further development, producing not only leaves but also flowering stems. The first leaves which are now developed upon these short, lateral shoots are merely scale-like.

Ranunculus abortivus.

Germinating plantlets of this species were exceedingly common during the month of April in shaded places in the woods, along the shore of the Potomac, in the vicinity of Washington. They occurred abundantly, together with older plants, and were easily distinguished from other species by the characteristic shape of their leaves. Fig. 10 in Plate V shows a germinating plantlet, in which the cotyledons are elliptical, obtuse, shortly petioled and united at their bases, forming a sheath around the plumule. There is a distinct, straight hypocotyl (C), and the primary root (R) is long, but rather thin and not branched. The same is observed in regard to the secondary roots, which seem to have been developed contemporarily, one at each side of the primary root. Only one leaf is developed at this stage, and its form accords entirely with that of the later ones, being reniform or sometimes almost cordate.

Another germinating plantlet, a little older, has been figured in Plate V, Fig. 11, merely differing from the last-mentioned in having an additional secondary root (r^2), which has come out behind the primary one. Otherwise there is no difference, but as soon as the second leaf appears a great change will be observed in regard to the growth of this very

young plant. The hypocotyl now begins to be bent towards the ground, and another root-system will be developed. We see then in Fig. 12 that the hypocotyl is no longer straight, and that it shows the beginning of a young root (r^3) at the base of the cotyledons, while the other roots still persist and even increase slightly in length. The first leaf has assumed its final shape and size, and another one (L^2) has commenced to unfold. If we follow the further development of the seedling we shall see, in Fig. 13, that there are now two distinct and different systems of roots, the first consisting of the primary and earliest developed secondary roots (r^1–r^2), the second consisting of two roots (r^3–r^4), the situation of which is below the cotyledons, or rather at the apex of the hypocotyl. The cotyledons are still green and attached to the stem, and four leaves have been developed. The primary root-system is now beginning to fade away, and is replaced by the second one, as may be observed in Fig. 14. Here the primary root has begun to die, the second ones next in the course of development have already faded, while the new set of roots is in rapid growth from the base of the young plant (r^1–r^5), being more or less thick, and some of them having several lateral branches. Three leaves (L^1–L^3) have finished their growth and a fourth one (L^4) has appeared. As soon as the plant has dropped the hypocotyl with the first system of roots it shows its final manner of growth, *i. e.*, several leaves crowded at the base of the flowering stem, and the roots fibrous.

This species should, according to A. Gray,* be biennial, but it is certainly perennial. For, if we consider the Fig. 15 on Plate VI, we shall see the rhizome and the base of an older plant, which is at least three years old. The plant does not flower during the first year, but forms only a number of leaves, while the following year the inflorescence appears. We see in Fig. 15 the persisting bases of the inflorescence (F^1) of a previous year (1889) and of some faded leaves, the plant then having attained an age of at least two years ; be-

* Asa Gray : Manual of Botany of the Northern United States, 6th Edition, revised by Watson and Coulter, 1890.

sides this we see the base of another flowering stem (F), which has been developed this year (1890), and finally a young shoot (S), which undoubtedly will produce a third inflorescence next year. This young shoot (S in the Fig.) corresponds to the young plant (Fig. 14), which is preparing to flower the following year, but with the difference that the last one (Fig. 14) contains the whole main axis, while the other one (S in Fig. 15) has been formed from a bud in the axil of one of the basal leaves of the older plant, and is then merely a lateral shoot on the main axis, now only represented by the very short rhizome.

Ranunculus recurvatus.

It was to be supposed that the germination of this species would be the same as described for the preceding one, *R. abortivus*, and it proves to be the case. There are, however, a few characters in which they differ, and these are easily discovered if we compare the drawing of *R. recurvatus* (Plate VI, Fig. 16) with that of *R. abortivus* (Fig. 12). The number of secondary roots from the base of the hypocotyl is larger in *R. abortivus* than in *R. recurvatus*, the cotyledons have rather longer petioles in *R. recurvatus*, and finally the young leaves are hirsute in *R. recurvatus*, whereas they are almost glabrous, or at least the blade is so, in *R. abortivus*. The margin of the leaves when young is crenate in *R. abortivus*, but in the other species it is serrate or sometimes even three to five-lobed. The full-grown plant of *R. recurvatus* shows, however, the same structure as do those of *R. abortivus* in regard to the short rhizome and the profuse development of fibrous secondary roots, while the primary root fades early, as does the hypocotyl.

Delphinium nudicaule.

The very peculiar germination of this plant has already been mentioned by several authors, and Bernhardi* has figured a similar case from a specimen of *D. fissum* W. K.

---

* Bernhardi: Ueber die merkwürdigsten Verschiedenheiten des entwick. Pflanzen-embryo. Linnaea, Vol. 7, 1832.

The principal difference from the usual manner of germinating consists in the presence of a cotyledonar sheath, formed by the petioles of the cotyledons, which are connate, forming a long tube, at the base of which is a small slit for the penetration of the plumule (Plate VI, Fig. 18 Sl). The cotyledons are long-petioled, with the blade ovate, slightly acute at the apex, and the two blades show also a tendency to grow together at their very base, leaving only a minute opening in the middle, representing the superior end of the tube. In one case (Fig. 17) there were developed three cotyledons, of which the blades were all equal in size and each of which showed the same nervation, so that it was certain that no division had taken place.

As to the primary root, this is relatively very large in the youngest state of the plant and shows early several lateral branches, which are densely covered with long root-hairs. Fig. 17 shows the first leaf coming out through the slit at the base of the tube. The cotyledons are persistent for a long time and do not fade away until four or even five leaves have been developed. The primary root is persistent as long as the plant lives, and increases gradually in thickness and ramification.

SARRACENIACEÆ.

Sarracenia purpurea.

Two germinating plantlets of this species were figured many years ago by Schnizlein,* and the figures show very exactly the part above ground: that is, the hypocotyl, the cotyledons and the first leaves. Further, in regard to the germination, Gray has described the cotyledons as being "short," which is, however, not correct according to the following observations, which have been made on numerous seedlings cultivated in the U. S. Botanical Garden.

A very early stage of the germination has been figured on Plate VII, Fig. 23, where we see the rather long, linear cotyledons, carrying the testa of the seed at their summit, the

---

* A. Schnizlein: Iconographia fam. nat. regni veget. 1843-46, Plate 185, Figs. 19 and 20. Asa Gray: Genera Flor. Boreali—Orientalis illustrata, vol. I, 1848, p. 108.

plumule, showing the first leaf (L^1), coming out at the very base of the cotyledons, and borne on a distinct, straight hypocotyl (C), at the base of which is a wreath of long root-hairs ; we see further the primary root, which is relatively short and unbranched. The whole germinating plantlet, except the root and the lowest part of the hypocotyl with the wreath of root-hairs, is now above ground, the testa of the seed is soon dropped and the cotyledons now spread out, being perfectly flat, green and entirely different from the later, the pitcher-shaped leaves. Fig. 25 shows a somewhat later state, where the first leaf has attained its full size and final shape, not differing essentially from the typical leaf of this species. It is an interesting fact that there are no transition-forms between this, the first leaf (Fig. 27), and the later ones. The hypocotyl is straight for some time, and the primary root grows slowly in length and does not show any ramification until later. The leaves now begin to develop, forming a dense rosette near the surface of the ground ; the cotyledons fade away, and, while the primary root has attained its final length, the secondary roots begin to grow at the upper part of the hypocotyl, just below the cotyledons. But before this stage, figured in Fig. 26, the plant has undergone some changes : the plumule, hitherto kept a little above the surface of the ground, has now gradually been moved downwards by the bending of the hypocotyl, a consequence of the zigzag direction of the primary root, which very soon disappears. By this mechanical movement the whole plant attains its final position in the soft mass of Sphagnum and is able to continue its growth and produce leaves and flowers.

PAPAVERACEÆ.

Sanguinaria Canadensis.

Germinating plantlets of this species were collected at the end of April in shaded places in the woods on the shore of the Potomac, where the plant occurs in great abundance. The seed germinates deep under ground, and the cotyledons never appear above the soil. They (Plate VII, Fig. 29) are oblong, obtuse, red and fleshy, and contain deep red juice like the

whole plant. The hypocotyl is relatively strongly developed, swells very soon after the appearance of the first leaf, and represents the first stage of the rhizome that is developed later. The primary root is slender, rather long, and shows several ramifications. It is the only root during the first stage of the germination, but very often after the appearance of the first leaf one or two secondary roots break out from the base of the hypocotyl. Figs. 28 and 30 show two germinating plantlets, and we see in these the somewhat swollen hypocotyl (C), the short-petioled, slightly curved cotyledons (Cot.), the slender primary root (R), and the development of one or even two secondary roots (r^1 and r^2). The first normal leaf is long-petioled, like those of the full-grown plant, but the blade is entire, not palmately lobed, as is the case in the later ones. The form of the young leaves is nearly kidney-shaped, the margin more or less crenate and the nervation palmate ; they may, however, also show an almost heart-shaped form, but they are always palmately nerved. The first leaf next the cotyledons shows the principal character of the final leaf, and (as appears in Fig. 30) the next one shows the same. One or two leaves are then developed in the first year, and during the following winter the hypocotyl increases in thickness and forms a roundish tuber. It is interesting to follow the further development of the young plant, and we see early the next spring that a series of scale-like leaves precede the normal ones. Fig. 34 shows such a young plant, one year old, where l^1–l^4 indicate four scale-like leaves, which are alternately biseriate. They are very thin, almost membranaceous, carinate and uncolored. The fifth leaf, L^5, is broadly heart-shaped, with the margin crenate. In regard to the hypocotyl, this has, as mentioned above, become still more swollen than in the first year, and, while the primary root still persists, some secondary roots have developed, of which r^1 and r^2 surpass it in length and thickness. These secondary roots are developed at different heights from the hypocotyl, above each other, and it was observed that they mostly break out on the same side, in which manner the hitherto vertical young rhizome is gradually forced into a horizontal direc-

tion, as in the mature plant. It is, however, to be observed that the number of scale-like leaves is far from constant; there may be developed merely two or three, as shown in Fig. 33. The same course in regard to the development of scale-like leaves succeeded by normal ones is to be noted in the full-grown plant, as shown in Fig. 35, where six scale-like leaves precede the two normal ones and the flower. The shape of the full-grown leaf is palmately lobed, but it shows a great variation in regard to the number of lobes (three or nine) and also in regard to the depth of the sinuses. But it is a constant character, that, not only the normal leaves of the young specimens, but also the first or second ones, belonging to the lateral branches of the main subterranean stem, the large rhizome, are similar in shape, always heart or kidney-shaped, without lobation. I did not observe in any case that the normal leaves on the lateral branches were not preceded by scale-like ones, and Fig. 36, which represents a lateral shoot, shows the presence of seven scale-like leaves, after which come two normal ones, L^1 and L^2. The full-grown rhizome (Fig. 35) is rather long, cylindrical, and dies off gradually at its posterior end. Most of the roots are strong, sparingly branched above, and very long, especially those proceeding from the inferior part of the rhizome. In regard to the whole growth of the rhizome, this has been shown to be sympodial by Mr. Foerste in his interesting paper, "Notes on *Sanguinaria Canadensis*,"* where he has also mentioned the singular case of the occurrence of a two-flowered scape.

VIOLACEÆ.

Viola palmata, var. *cucullata*.

The germinating plantlet of this species (Plate VIII, Fig. 37) shows the long-petioled, ovate cotyledons, the distinct hypocotyl (C), the unbranched primary root (R) and the two secondary ones (r^1), which have been developed at the same time. There is a great difference between this early state and

---

* Bulletin of the Torrey Bot. Club, Vol. XIV, No. 4, 1887.

the final development of the plant, even if it is quite easy to trace the later transformations of some of the organs.

A few weeks after this first state, and while the cotyledons still persist, the hypocotyl commences to increase in thickness, as shown in Fig. 41, and the roots to form branches; the first leaf (L^1) has come out, is cordate and crenate, which is characteristic of this variety. By continuation of growth the hypocotyl has now been transformed to an obconical body (C in Fig. 40), which is crowned by the swollen bases of the two leaves (L^1 and L^2), while the root-system has undergone no change in regard to the further development of secondary roots. The cotyledons have dropped, leaving a semi-lunate scar at the upper part of the hypocotyl, which is shown in Fig. 38. Plate VIII.

The structure of the rhizome is now indicated, being fleshy and almost toothed, the teeth representing the swollen base of the successively dropping leaves. This may be seen in Fig. 39, which shows the rhizome of a plant one year old, where the primary root still persists, although it has partly faded. The secondary roots (r^1) are unchanged, and we see another pair of roots developing a little above them, between the scars of the cotyledons, and alternating with the older pair (r^1). Five teeth are visible in this figure and show their origin very distinctly, the base of the petiole. The rhizome of this specimen was vertical, but it gradually becomes almost horizontal, creeping under the surface of the ground. We have then a strongly developed rhizome before us, of which the leaves are not scale-like, but perfectly normal and densely covering the rhizome. The persistent bases of the petioles and stipules contain a large quantity of starch.

LEGUMINOSÆ.

Lespedeza violacea.

Fig. 43 on Plate IX shows a germinating plantlet of this species, where we see a long primary root, carrying a few tubercles, especially upon the lateral branches. The cotyledons are short-petioled, obovate and obtuse, and the hypocotyl is straight and very distinct. The first leaf is unifoliolate,

while the later developed ones are trifoliolate, but with the leaflets of the same shape as the first one. That the primary root is long persistent is to be seen in Fig. 44, which represents the rhizome of a flowering plant. The tubercles are also especially to be observed here on the lateral branches of the root and we see further the short, ascending rhizome, merely consisting of the lowest part of the stem, from the base of which buds are developed, forming the prostrate, decumbent branches.

Lespedeza procumbens.

In regard to germination this species differs a little from the above-mentioned one in having the first leaves, next the cotyledons, opposite. They are unifoliolate, with the leaflets broadly cordate and pointed, while these in the final leaves are obcordate, with the apex retuse (Plate IX, Figs. 45, 46). The first two or three leaves next to these show the same shape, but are alternate. The whole germinating plantlet otherwise much resembles that of *L. violacea*, as regards the shape of the cotyledons, the development of the hypocotyl and the primary root. The rhizome of the full-grown plant (Fig. 46) agrees entirely with that of *L. violacea.*

Clitoria Mariana.

There are a few points of interest which may be mentioned in the germination of this plant. The hypocotyl is rather long, straight and pubescent, while the cotyledons, which are sessile, ovate and obtuse, are perfectly smooth. The first two leaves, next above the cotyledons, are opposite, ovate and acuminate, and the primary root is slender, with several thin branches, but destitute of any tubercles. There is quite a considerable difference between a germinating plantlet of this species (Plate IX, Fig. 47) and of that of *C. ternatea*, which has been figured by Lubbock.* In this species, the cotyledons are more obtuse, and the first leaf after them is already trifoliolate.

As to the full-grown plant of *C. Mariana*, the leaves are

* Sir John Lubbock: Phytobiological Observations, Journal of Linn. Society, Vol. XXII, 1887, p. 355.

trifoliolate, with the leaflets ovate and obtuse. There is a rather short rhizome (Plate X, Fig. 49) with a strongly developed and persistent primary root (R) upon which no tubercles were observed.

Cassia Chamaecrista

and *C. nictitans* L. show the same manner of germinating as represented on Plate X, Fig. 50, where a seedling of *C. Chamaecrista* has been figured. The only difference between these species during the germination period is that *C. Chamaecrista* is larger in all details. The cotyledons are above ground, sessile and roundish, borne on a hypocotyl which is not very long. The primary root is long and slender, and shows at this very early stage the small tubercles, which are so characteristic of most of the Leguminosæ. Lateral roots have been formed, but these are as yet rather short. The plumule has developed an erect stem, of which all the leaves, even the first one, show the same shape as the later ones, being pari-pinnate and minutely hairy along the margin of the leaflets.

ROSACEÆ.

Rubus hispidus.

Fig. 51 on Plate X shows a germinating plantlet of this species, and we see there the two short-petioled, ovate and obtuse cotyledons, borne on a distinct hypocotyl. The primary root (R) is slender and shows several lateral branches, while no secondary roots are as yet to be observed. The plumule has developed a glandular-hairy stem and carries a few nearly reniform leaves, which show the same glandular hairiness as does the stem. The leaves are serrate in this very early state, and no other form of leaf will develop even in the next year. Fig. 52 represents a plant two years old, and shows approximately the same shape of the leaves, with the exception that the blade is proportionally narrower and acuminate, a form which is very different from that of the leaflets of the final leaves. We further see in this figure the persistence of the primary root, and a very short rhizome, from which three secondary roots have been developed. St.[1] is the main stem, which is much longer than the second-

ary one, St.[2], which has been developed from the axil of the first leaf. The whole plant was glandular-hairy, like the germinating plantlet.

Potentilla Canadensis.

The cotyledons of this species are entirely under ground, short-petioled, with the blade ovate and rather fleshy. The hypocotyl is short and covered with minute glandular hairs, as are also the cotyledons, and the primary root is strongly developed, long, and branched at an early stage. This is to be seen in Plate X, Fig. 53, where we also see the rapid development of the plumule into an axis, which is runner-like, ascending with several leaves, of which the first one differs from the final one in being almost kidney-shaped, with the margin coarsely serrate; the other leaves are palmately trifoliolate.

When the plant has attained its full growth, a rhizome is to be observed, which is often tuberous and with the primary root still persisting (Fig. 54).

SAXIFRAGACEÆ.

Saxifraga Virginiensis.

The seed of this species germinates early in the month of March, and the germinating plantlet is especially characterized as having short-petioled and broadly ovate cotyledons, which are above ground, a distinct, erect hypocotyl, and a long, filiform primary root (Plate X, Fig. 55). When the leaves begin to unfold the hypocotyl bends downward to the ground after having developed two or three secondary roots that very soon surpass the primary one. The first leaves are broadly ovate or elliptic, sparingly hairy, with stellate hairs on the upper surface of the blade, and the petiole is slightly pubescent (Figs. 56 and 57). When the plant grows older, the primary root disappears entirely and is replaced by several secondary roots, and in Fig. 58 we see the beginning of the formation of the very short, vertical rhizome that is provided with a few roots and is represented by the superior part of the hypocotyl. Five leaves were developed

on this specimen (Fig. 58), of which the three oldest showed the same form as the ones mentioned above (Figs. 55–57), while the two younger were almost cuneate and bidentate, pubescent on both surfaces as well as on the petiole. The plant now continues its growth in this manner, developing a leafy rosette upon the apex of the short rhizome, and some buds will also develop in the axils of these leaves, so that the rhizome finally will carry a crown of leafy rosettes, some of which will contemporarily produce flowering stems in the following years.

DROSERACEÆ.

Dionaea muscipula.

The very first stage of germination, figured on Plate X, Fig. 60, shows the development of the primary root, which is densely covered with blackish hairs, especially at its upper part where it joins the hypocotyl. For some time the testa of the seed is carried by the apex of the cotyledons, but after it drops off the cotyledons spread a little (Fig. 61), and the plumule begins to form the first leaves. These, even the first one next to the cotyledons (Plate XI, Fig. 62), show the characteristic shape and peculiar function which has made the plant one of the most interesting in the world. The germinating plantlet can now be characterized as having narrow lanceolate cotyledons, a distinct hypocotyl and a relatively short, blackish-hairy primary root. While the leaves begin to develop in the form of a small rosette, the growing point is moved from its original place between the cotyledons to outside these, as has been shown in Fig. 63. At this point the first secondary root is developed just below the foremost part of the horizontal, now creeping axis, and it is already indicated how the plant will continue its growth. A distinct horizontal rhizome will be developed, which is very easily seen in the older plants, of which one is figured in Fig. 64, while Fig. 65 shows a longitudinal section of the same specimen. The fresh leaves form a rosette, as has been described by various authors, but it is by no means correct to call the

plant "acaulescent," as do for instance A. Gray,* and Bentham and Hooker.†

While Fig. 63 shows the plant at a very early stage, with a small rosette of green leaves and the beginning of a creeping rhizome, indicated by the position of some of the leaves outside the cotyledons, together with the development of a secondary root at some distance from these, Fig. 64 illustrates in the older specimen the true rhizome, creeping with rather thick, short and still unbranched roots, with the base of the leaves of the previous year still persisting. The internodes of the rhizome are, when young, exceedingly short, and it looks therefore as if the leaves formed a true rosette—that is, as if they were arranged alternately upon a short, erect axis with the blades spread out horizontally as, for instance, in *Drosera rotundifolia*, instead of upon a decumbent, creeping stem.

The bases of the leaves are, as mentioned above, persistent for a long time, whereas the faded blades disappear very soon, and it has been observed that a large quantity of starch is deposited here. The leaves of *Dionaea* have then a double function in being organized for the purpose of capturing and devouring insects, after which they serve as reservoirs, which contain quite considerable deposits of starch, as do the fleshy bulb-scales of many monocotyledonous plants.

UMBELLIFERÆ.

Thaspium barbinode.

The cotyledons are like those in most Umbelliferæ, that is, above ground, and long-petioled with a lanceolate blade. The hypocotyl is here either very short or, what seems to be the most common case, entirely wanting. The primary root is, on the contrary, strongly developed, thick and only sparingly branched. No secondary roots are developed during the first year and probably not in the second. Fig. 66 (Plate XI) shows a germinating plantlet, the plumule of which

---

* A. Gray: Gen. Ill. vol. I, p. 196.

† Bentham and Hooker: Genera plant.

has already developed two leaves that show in general features the shape of the final ones, but they have a smaller number of divisions than the later ones. We see in Fig. 67 an abnormal case, where three cotyledons have been developed, but the seedling does not differ in other respects from the above-mentioned description of this (Fig. 66). The young plant will continue its growth in that manner, the primary root will gradually attain the shape of a so-called tap-root (Fig. 68), while the proper rhizome will show merely a short, nearly subterranean axis, upon which leaves will develop until the inflorescence terminates the main axis, after which the plant will be renewed by the development of buds in the axils of the basal leaves. A full grown plant has several shoots upon the rhizome, at the base of the flowering stem, and beside the primary root a few secondary ones were observed which were almost the same size.

Thaspium aureum.

This species agrees in most respects with the one above described, the only difference being in the shape of the leaves. Fig. 69 in Plate XI shows a germinating plantlet, of which the cotyledons and the primary root show the same development as in *T. barbinode.* The first leaf, on the contrary, has not any separate division, but is almost entire or slightly five-lobed, with the margin sharply serrate.

Osmorrhiza longistylis.

The germinating plantlet (Plate XI, Fig. 70) has a strongly developed primary root, but the hypocotyl is rather inconsiderable. The cotyledons are long-petioled, with linear blades, and are entirely above ground. The first leaf shows relatively the shape of the final ones, with the exception that it is smaller and has only three divisions, the shape of which, however, accords in many respects with that of the later leaves. It is to be noted that the form of the divisions of these decompound leaves, "broadly ovate, with the margin serrate," is not the only one which occurs in this species. We shall see, at a later stage of development (Fig. 71), where the cotyledons have dropped and where the leaf (L^1) shows a somewhat

different form in regard to the divisions. These are more compound than those of the first-mentioned specimen, and the divisions are not ovate, but cuneate, with the margin sparingly dentate. Another circumstance is that, while the final leaves are densely pubescent, this leaf is almost glabrous. The specimen figured in Fig. 71 is one year old, the primary root has increased in length and thickness, and has developed several long, filiform lateral roots. A rhizome (Rh.) is already formed, and it consists of the short internodes of the first year, carrying the above-mentioned leaf (L^1) and two other ones of which the second shows the same shape as L^1, while the third one has the normal form, described above. It is therefore shown that the first leaves in the second year of the life of the plant are different in form from the later ones, a fact which seems to be constant.

We see, if we examine a full-grown plant, that the leaves show the same different aspect in regard to the size and shape of the divisions, and it is always the leaves that are the first to develop in the spring which have the smallest and almost cuneate divisions. In regard to the rhizome, this is vertical and rather short, carrying several small buds, which will develop leaves in the following years. The primary root persists, as it seems, as long as the plant lives, and several secondary roots are developed from the base of the rhizome, some of which are thick and similar to the primary root and contain a large deposit of starch, or they are thin, very strong and much branched like the common roots. It is to be noted, in regard to this plant, that it seems as if it had been hitherto overlooked, that it has dimorphous leaves, a character which ought to be mentioned in the diagnosis of the species.

Sanicula Marylandica.

The cotyledons are long-petioled, with an ovate-lanceolate blade, which is short-pointed (Plate XI, Fig. 72). The hypocotyl is straight, well developed, as is also the long and slender primary root, which is shown in Fig. 73. These are the features in general for the primary stage of development, but

the plant will gradually undergo rather considerable changes. The next stage will be (Fig. 74) where the leaves have commenced to come out, and this drawing was made from a plant two months older than the first one described (Fig. 73). We now see that the hypocotyl has been bent and is lying upon the ground. The primary root persists, but has now begun to fade away. Another root-system is formed at this time, consisting of two strong, secondary roots, which proceed from the bases of the cotyledons, which have fallen away. These roots are very long, sparingly branched and rapidly surpass the primary one in length and thickness. We therefore have an umbelliferous plant, where the roots at an early stage are all secondary, while commonly in this order, as it seems according to descriptions, the primary root persists for a long time or even during the whole life of the plant. The rhizome of the full-grown plant is very short, merely represented by an exceedingly short, vertical axis, upon which buds are at length developed, producing for several years leaves and flowering stems.

ARALIACEÆ.

Aralia spinosa.

The seeds of this tree did not germinate for about eighteen months after they had been sown, and the young plants all showed the peculiar fact, that the cotyledons were unequal in size and shape. The one had the common form of a cotyledon, being oblong and obtuse with the margin entire, while the other one was smaller and ovate, with the margin serrate. That is, however, the only thing which characterized the germinating plantlet of this species (Plate XI, Fig. 75). The primary root was not very strongly developed and showed only two lateral branches, the hypocotyl was rather long and the first leaf next the cotyledons showed approximately the same shape as the final ones, but had only three leaflets.

URTICACEÆ.

Pilea pumila.

The typical shape of the leaf of this species is broadly ovate, with a long point and a coarsely serrate margin, a form

which differs very much from that of the first two pairs of leaves of the germinating plantlet (Plate XII, Fig. 82). We see in this figure that the first pair of leaves, next the cotyledons, are ovate, but with the margin perfectly entire and the apex obtuse, while the next pair (Fig. 83) show a slight lobation, with a long middle-lobe, forming the transition to the serrate margin and the long point of the final leaves. The cotyledons are long-petioled, with the blade broadly oblong and the apex slightly retuse; the hypocotyl is straight and long, and the primary root, which is slender, shows several ramifications.

PALMÆ.

Sabal Palmetto.

The fruit of this genus, which belongs to the tribe *Corypheae*, is a black, monospermous, dry berry. The albumen is cartilagineous and the apex of the cotyledon is transformed to a conical spongy body, closely imbedded in and absorbing the albumen. When the germination begins, the thick, conical primary root penetrates the pericarp and carries the plumule along with it. The plumule is, however, not visible at the very early stage of germination, figured on Plate XIII, Fig. 84, but is enclosed by the base of the cotyledon, which is represented here by two clearly differentiated parts, the above-mentioned conical spongy apex, enclosed by the albumen, and the free cylindric base. A short time later —that is, after one or two weeks—the anterior part of the base of the cotyledon begins to show a small protuberance, which quite rapidly grows outward towards the surface of the ground, attains a length of one inch or even more, and becomes at last ruptured by the penetration of the plumule, and forms a cylindrical closed sheath around it. The first leaf alternates with the cotyledon, is whitish, scale-like and partly sheathing, and encloses the base of the next leaf, which is green and lanceolate in shape. As to the primary root, this dies off very soon, almost simultaneously with the appearance of the second leaf, and forms a thickish, conical body, entirely destitute of ramifications. Fig. 86 shows a young plant, where the fruit has disappeared, together with the en-

closed and the free part of the cotyledon, with exception of the still persisting sheath (Sh. in the figure), around the base of the leaves. The first leaf (l^1) is almost faded.

The second one (L^1) is rather large, lanceolate and shows the longitudinal foldings, which are so characteristic of the first leaves of most of the palms. A third leaf (L^2) has come out and is of the same shape as the second, and will be followed by several others, similar in form, before the normal, fan-shaped leaves appear. We see further in this same plant that two secondary roots have been developed a little above the primary one, and these are growing rapidly in length and have a great tendency to ramification.

Closely allied to this genus is *Nannorhops Ritchieana*, Griff., from Asia, of which some fruits were sown at the same time as those of *Sabal*. The germination accords nearly with that of *Sabal*, but there is, however, a difference in regard to the further development of the primary root. Plate XIII, Figs. 87–91, illustrate the germination of this plant, and in these figures is shown the gradual growth of the primary root. It grows much faster than the sheath of the cotyledon can be formed, and is not destitute of lateral branches, as was the case with *Sabal*. Fig. 90 shows a later stage of development, where the first two leaves have come out and are surrounded by the sheathing part of the cotyledon, as in *Sabal*, but the primary root has not yet faded away, but, on the contrary, it continues to grow. At a still later state, figured in Fig. 91, where in all three leaves have been developed (l^1, L^1 and L^2), it seems to have stopped its growth and commences to swell at the lower extremity, while the lateral branches continue their growth. The first secondary root is to be seen in this same state; it surpasses the primary one and has numerous ramifications. The fruit was still attached to the plantlet, but in the most essential details the germination did not show any great differences from that of *Sabal*.

Attalea excelsa.

The apex of the cotyledon has the same shape and position as described for *Sabal*, but the basal part seems to be rela-

tively longer in this plant. It does not appear that more than one of the seeds in each fruit germinates, at least not generally, but this happens occasionally, however, and was observed in one case where two germinating plantlets were developed from the same fruit. Fig. 92, in Plate XIII, shows an early state of the germination, and we see there the cylindrical, free part of the cotyledon, of which the extremity is somewhat swollen and contains the plumule, as in Fig. 93, which represents the same specimen, divided longitudinally. We see further a short-pointed, conical tip below the plumule, from where the primary root will come out. One month later the plumule appears, and the base of the cotyledon forms a sheath around it similar to the one described in *Sabal* and *Nannorhops*. The first leaf ($l.^1$ in Fig. 94) is whitish, almost tubular and alternates with the cotyledon. At the same time the primary root has further developed and shows several lateral branches, but no secondary roots have appeared. It is now to be pointed out that the primary root attains a very advanced development, not only in regard to length, but also as to its ramification. We have then two scale-like, sheathing or rather tubular leaves, preceding the green or first assimilating leaf, which, as shown on Fig. 95, is broadly lanceolate and folded, as is characteristic in the Palm Family. This figure (Fig. 95) has been drawn from a specimen seven months older than the one above described. The fruit has now become separated from the young plant, and there is left only the partly faded, fibrous base of the cotyledon. The first and second leaves (l^1 and l^2) are also beginning to fade, and no other root has been developed beyond the primary one, which continues its growth in length and with the lateral branches increasing in number.

CYCLANTHACEAE.

Carludovica palmata.

Belongs to the tribe "Carludoviceæ," of which the seed has a very copious albumen. The cotyledon is fusiform (Plate XIV, Fig. 96) and is entirely enclosed in the seed during the germination, excepting the foremost part, the very base

which encloses the plumule and later forms the sheath around it. The primary root (R) is the first part of the seedling which becomes visible, and grows rapidly out, although not attaining any considerable length. It is hairy above and entirely unbranched. Fig. 96 represents the germinating plantlet, where the above-mentioned parts are visible besides the two first leaves, the first of which alternates with the cotyledon and is broadly lanceolate, three-nerved and with a sheathing base. The next stage of the germination may be seen in Fig. 97, which shows the appearance of a third leaf, the continued growth of the root, and finally the formation of a very short, but distinct epicotyl between the cotyledon and the first leaf. No secondary roots have come out yet. A few weeks later the young leaves are further developed (Fig. 98), the second and third (L^2 and L^3) being ovate, pointed, five-nerved and with the base partly sheathing. The fourth leaf (L^4) has come out, and, in regard to the root system, we see that a secondary root (r^1) has been developed from the epicotyl, and only a little above the primary one, which has attained its full size, while the other one grows rapidly and has already surpassed it in length.

In a later stage (Fig. 99) the plant has dropped the cotyledon and thereby lost its character as a germinating plantlet. The primary root still persists and another secondary root (r^2) has been developed at the base of the first leaf (L^1) and opposite the first root (r^1), both of which are still unbranched.

This is the general course of the growth of this plant, it being exceedingly short-stemmed, with all the roots confined to the base of the stem, which is entirely under ground. The leaves gradually change their shape from ovate and sheathing to fan-like and long-petioled.

AMARYLLIDEÆ.

Agave univittata.

The seed germinates in the ground and the primary root is the first organ that develops. It is densely covered with root-hairs, especially at its upper part, and does not show any tendency to ramification for a considerable time. Fig. 100

shows an early state of the germination, and we see here the primary root (R), the hypocotyl (c) and the long, cylindrical cotyledon, bent and forming an acute angle, of which the apex is still enclosed in the seed. It will be so for a short time, after which it gradually lengthens, lifting the testa of the seed above ground, as shown in Fig. 101. When the testa of the seed drops the free summit of the cotyledon shows a somewhat faded aspect (Fig. 102), and at this time the plumule commences to appear through a slit (Sl), which has been visible for some time at the base of the cotyledon. The cotyledon is then green, and is of almost the same shape as the first leaves, except that the apex soon fades away.

The hypocotyl shows an axis at a very early stage of the development of the young plant, while the following internode is exceedingly short, until at last the long-stemmed inflorescence terminates the main axis.

Eucharis candida.

In this species when the seed germinates the primary root is the first to appear and grows out quite rapidly. The apex of the cotyledon is imbedded in the albumen and never becomes free, while the base forms an almost tubular body, enclosing the plumule, as shown on Plate XIV, Fig. 103. At a later stage (Fig. 104) the first leaf has come out and alternates with the cotyledon, is long-petioled, with the blade elliptic, tapering at both ends like the final leaves of this species, and we see further the development of the first secondary root. The primary root still persists and shows, like the secondary one, a distinct wrinkling in the upper part, the cause of which will be mentioned later. The base of the cotyledon has increased in thickness and shows an opening above, through which the first leaf has come through, and the whole base shows the beginning of the formation of the bulbous rhizome of the plant, the sheath of the cotyledon persisting for a long time and representing the first bulb-scale.

LILIACEÆ.

Smilax rotundifolia.

The material, which has been examined to illustrate the germination and the formation of the rhizome of this plant,

was collected in the large Smilax thickets which so commonly occur in open places in the woods along the shore of the Potomac, and in spite of the great similarity that exists between several of the woody species of Smilax when young, these plants showed a few characters which were sufficient to distinguish them as belonging to the species "*S. rotundifolia.*"

In regard to the structure of the rhizome of the whole genus Smilax, it is remarkable to see how few observations have been made, and, with the exception of the two species, *S. Pseudo-china*, L. and *S. hispida*, Muhl., none of the other North American representatives have been examined with reference to their rhizomes. Another fact is, that there seems to be a certain kind of variation in the young foliage of this species, which it might not be superfluous to describe in connection with the germination and the structure of the rhizome.

Turning to the examination of our species *S. rotundifolia*, the seed germinates deep in the ground for a long time with the fruit attached, Plate XV (Fig. 105). There is a distinct, sheathing cotyledon, as shown in Fig. 106, where the upper part of the cotyledon has been removed from the albumen in which it was closely imbedded. Besides this enclosed part there is to be observed a free one, which is the base, and which forms a sheath around the plumule.

There is also a hypocotyl (c in Figs. 105-107) more or less developed, but never wanting, as it seems, according to the numerous seedlings which were examined. The primary root is rather slender, branched at an early stage, and persists for at least the first year. The plumule, after having penetrated the cotyledonar sheath, develops an ascending stem, the first one to three leaves of which are under ground, scale-like and partly sheathing. After these leaves the normal ones appear, and diverge more or less from the typical shape, which has been described as "ovate, or round-ovate, and slightly heart-shaped" for this species.

These are the general features of the germinating plantlet, and we shall now see how the rhizome commences to develop.

Several seedlings were collected in the stage figured in Fig. 108, which shows the base of the young plant, and we see that the fruit with the apex of the cotyledon has dropped, while a swelling has taken place at the base of the stem and inside the persisting sheath of the cotyledon. This is due to the presence of a conical bud, which has been formed in an earlier state (Fig. 107), but has now grown farther out, having attained quite a considerable size in the stage of growth figured in Fig. 109. The place of this bud is in the axil of the cotyledon, just at the back side of the main axis, as is shown in Fig. 107. This bud seems most frequently to develop into a tuber (Fig. 111), and it is to be pointed out that the apex of the bud will gradually bend downwards so that the axis of the tuber describes a horizontal direction. The first leaf upon this tuber turns its back towards the main axis, as does the first leaf upon each secondary branch in most monocotyledonous plants. This fact is especially to be seen in Fig. 110, where the bud has not formed a tuber, but has developed immediately an ascending branch, at the base of which we see the adorsed scale-like leaf, the "prophyllum," while the remaining sheath of the cotyledon is to be observed at Sh. and the main axis at A. In regard to the root-system, the secondary roots are growing out already in the first year (Figs. 108, 110, 111); they are thicker than the primary root, whitish and merely sparingly branched. They have been developed from the upper part of the hypocotyl, the first one regularly on the anterior face of the germinating plantlet, just below the slit of the cotyledonary sheath. In Fig. 111 we see the beginning of the formation of the rhizome and the slight difference due to the relative size between the young rhizome and that of an older plant, shown in Fig. 112. We see in this last figure the full-grown rhizome, which is relatively short, horizontal, tuberous and provided with several strong roots. The base of the ascending stems is more or less tuberous, covered with scale-like leaves and very often rooting at the nodes. The youngest part of this rhizome shows a comparatively large tuber with an ascending stem (1), which will eventually produce leaves and probably also

flowers the same year. The base of two other stems are to be seen at 2 and 3, indicating their rank in regard to their time of development, No. 3 being the older one, and these stems carried several leaves which had persisted over winter.

The three other basal parts (Nos. 4, 5 and 6) were the only remaining parts of old faded stems, and the probable age of the whole plant was at least six years. Only one stem had been developed each year in this specimen, but the period necessary for the formation of the tubers (say, for instance, the younger one, which was relatively longer than the other ones and was covered with about three scale-like leaves) is uncertain.

As regards the foliage of *S. rotundifolia*, as already remarked above, there seems as if there were quite a considerable variation even in the same specimen. The form, indicated as typical for this species, should be, according to De Candolle (l. c.), "limbi ovati vel ovales, basi subcordati, obtusi vel prope petiolum cuneati, apice (in eodem ramo) sæpius acute cuspidati vel acuminati, et interdum obtusi." The most characteristic feature of the leaf, when the question is to distinguish it from other species, for instance, *S. glauca*, with which the young specimens showed a great resemblance, is the minutely dentate margin. As regards this character it accords, however, with *S. hispida*, Muhl., but the leaves of this species show from seven to nine nerves, whereas there are not more than five to seven in *S. rotundifolia*. The consistency of the leaf is also different, as the leaves of *S. rotundifolia* are thick, almost coriaceous, in contrast to the leaves in *S. hispida*.

We will shortly consider the leaves of *S. rotundifolia*, figured on Plate XV, which have been taken from a full-grown plant, or from very young specimens, the ages of which were only one year.

The leaf in Fig. 121 shows the typical form, while the other one (Fig. 122), which has also been taken from an older plant, is more elongated and tapers gradually to the pointed apex. We find this form again in Fig. 113, which shows the youngest leaf of a one-year-old plant. In Fig. 114 we see

another leaf which belonged to the same branch of the above-mentioned plant, but was the oldest one, and the shape of which is approximately cordate. The broadly roundish cordate form is represented in the leaf in Fig. 119, which leaf was succeeded by the regularly heart-shaped one shown in Fig. 120. This, the roundish and more or less cordate form, seems to be the most common one in the young plants, but we might also find the more ovate and sharply pointed form, as, for instance, in the leaves (Figs. 116–118), all of which belonged to the same branch of a very young specimen, 116 being the youngest and 118 the oldest one. There is then quite a considerable variation in the foliage in this species, so that forms might occur more or less approaching those of the above-mentioned species, *S. glauca* and *S. hispida*. We have accordingly to take refuge in the structure of the leaf, and it seems that some characters are to be found here. The anatomical difference must now be looked for in the presence or absence of stomata and in the undulations of the cell-wall of the epidermis. The epidermis of *S. glauca*, taken from the superior face of the leaf, does not show stomata, while in the two other species stomata were present and not in small numbers. The number of the cells surrounding the stomata was nearly constantly two in *S. hispida* and four in *S. rotundifolia*. The relative size of the epidermis cells was also somewhat different, and, while the undulations were the same in *S. glauca* and *S. rotundifolia*, the cells of *S. glauca* were proportionally larger than those of *S. rotundifolia*. In *S. hispida* the cell-walls showed merely a very slight undulation, and the size of the cells was almost the same as in *S. glauca*. If we were to examine the epidermis from the inferior surface of the same leaves, we would find stomata present in great numbers, and equally so in all three species. The undulations of the cell-wall were slighter than those described for the upper surface, especially in *S. hispida*, in which the cells showed a rectangular or rhombic form.

Smilax glauca.

A germinating plantlet of this species, figured on Plate XV, Fig. 123, resembles very much that of *S. rotundifolia*,

described above, the only difference being that the margin of the final leaves of *S. glauca* is entire and never toothed, as in the other species. Otherwise the structure of the cotyledon, the primary root, the presence of a hypo- and epi-cotyl and the scale-like shape of the first three to five leaves agree entirely with what we have seen in *S. rotundifolia.* In regard to the development of the rhizome there seem, however, to be some slight differences, by which the underground parts of these two species, at least at a later stage, are to be easily distinguished.

The rhizome of *S. glauca*, figured in Figs. 124–126, is strongly tuberous and consists of a chain of tubers, due to the swelling of the short internodes of the subterranean stem, and in such a manner that each tuber represents from three to four internodes, the leaves of which are scale-like and very broad. From each tuber proceeds a stem, of which the lower leaves are scale-like and partly sheathing. The direction of the stems is ascending, and after having reached the surface of the ground the final leaves will replace the scale-like ones.

The whole rhizome shows a great similarity to that of *Polygonatum*, excepting that the stems exist for several years. Fig. 124 shows the rhizome of a younger specimen. Only two stems have been developed, of which *a* is of this year's growth, not having yet penetrated the ground, while the other one, *b*, in the figure, represents the base of a stem that is evidently three years old. The rhizome itself is horizontal with cylindrical internodes, whitish, and does not emit any large number of roots. They, the roots, are rather few and are especially developed from the inferior part of the tuber. The larger rhizome, Fig. 126, is from an older plant, and we see here three tubers and altogether three stems of different ages. The course, in regard to the whole development of the tubers and the stems, is, however, the same as shown above for the younger specimen (Fig. 124). It is to be observed very distinctly in the older specimen, that the stems are supported by the subterranean scale-like leaves of the tubers, and we see, for instance, in B a small wart-like body, which is a bud,

eventually developing into a stem, most probably in the following year.

There is no regularity in regard to the number of internodes by which the tubers are formed ; it seems to vary from three to four. The form of the tubers is, on the contrary, very uniform, cylindrical, broadest at the middle, and tapering at both ends. They contain a large quantity of starch. Fig. 127 illustrates the underground part of a very old plant, and we there see that the true tuberous rhizome is wanting. The whole rhizome consists merely of a stolon, which has been separated from the primary rhizome, and of which the ascending branches proceed from small tubers, each representing one single internode. It denotes the fact that the lateral branch (br^2) has been developed from the axil of a scale-like leaf, without being preceded by any formation of tubers, while the main branches (Br^1 and Br^2) form tubers above each leaf, which support a lateral branch. Strong roots proceed from the inferior face of the tubers, while the stolons otherwise are mostly destitute of roots. It is especially the ability of forming these tubers that makes the stolons able to continue their life after having been separated from the main rhizome of the plant.

Hemerocallis fulva.

This plant is not properly indigenous to America. It is a native of Europe, but has been cultivated here for a long period and sometimes occurs escaped from cultivation. A germinating plantlet has been figured on Plate XVI, Fig. 128, where we see a rather strongly developed primary root (R) and one secondary root (r) which has grown out through the base of the sheath that is formed by the cotyledon. The cotyledon itself is partly enclosed in the seed, or at least its apex is, while the base is free and forms, as mentioned above, a sheath around the plumule, which has developed three leaves (L^1–L^3); the latter are linear and carinate. The plant shows the same general course of development in regard to its germination as do most of the monocotyledonous plants, but there is, however, quite an interesting fact, which must

be taken into consideration. This is the distinct wrinkling, which the primary root shows, and which may be observed also in the secondary root, when it has grown out to its full length, as shown in Fig. 129. This peculiar fact (the wrinkling of the roots) depends on their ability to contract, and, as explained by Irmisch, is for the purpose of keeping the plant as close to the ground as possible. The older state of the plant, figured in Fig. 129, shows also that the secondary root (r) has increased quite considerably in thickness, being almost fusiform, taking the function of a nutritive root, and contains a large quantity of starch, like the tuberous roots, of *Orchis*, *Dahlia* and several others.

Yucca gloriosa.

The seed of this species is compressed, almost triangular, with a corneous albumen. A longitudinal section of the seed (Plate XVI, Fig. 131) shows the fusiform apex of the cotyledon, lying diagonally in the albumen. When the seed commences to germinate the primary root is the first that appears; it is rather thick and attains a considerable length before the plumule becomes visible. Figs. 130 and 132 show this very first stage of the germination, and we observe there a slight bending downwards of the cotyledon, so that the seed is kept under ground during this, the first, stage of the germination. The lower part of the cotyledon shows very early an incipient swelling, which is caused by the growth of the plumule inside. Fig. 133 shows the plumule (P) coming out, but in other regards the germinating plantlet has not changed from what has been figured above. But after that time, when the first leaf has been developed (L^1 in Fig. 134), some very considerable changes have taken place. The primary root has grown rapidly out, and shows already some lateral branches, and the cotyledon has commenced to stretch itself upwards, so that the seed is entirely above ground, still being for some time carried by the apex of the cotyledon, the base of which shows the swelling, mentioned above, and has even increased in length. The first leaf alternates with the cotyledon, is broadly linear, pointed and five-nerved. In the next stage

of the germination, figured in Fig. 135, the second leaf has appeared, and contemporarily the primary root has attained a considerable length, with a few ramifications. The base of the cotyledon seems to have decreased in thickness, and will gradually fade away, leaving a somewhat fibrous sheath around the base of the young plant, as is shown in Fig. 136. This plant (Fig. 136) was about one month old, and we can see the continued growth of the primary root, that has acquired several lateral branches, but no secondary roots have been developed. The cotyledon has partly dropped, at least the upper part, while the lower is still persistent, forming a narrow sheath around the base of the young plant. No axis nor internode is visible, and the plant will not develop a longer stem, the leaves all being situated near the ground, forming a dense rosette. The development of the secondary roots is very late, and the primary root persists for about half a year. Fig. 137 shows a young plant, the age of which is eight months. We see in this figure four secondary roots (r–r), of which two are relatively more strongly developed than the other ones; the latter are rather thin, but provided with several lateral branches in contrast to the two others, the thicker ones. There is only a scar (R) left from the primary root, but the plant has not been changed in any other respect, except by the addition of leaves to the ones figured in Fig. 136.

ARACEÆ.

Peltandra undulata.

The fruit of this plant is a fleshy berry, of which the pericarp is very thin, notwithstanding that it is tough when fresh, dark colored and almost black (Plate XVII, Fig. 138). The enclosed seed (Plate XVII, Fig. 140, there being most frequently only one) is globular, surrounded by a tenacious jelly which, according to Baillon and Engler, is the transformed exterior integument of the ovule. The plumule is green and lies in a furrow formed by the large scutellum, the margins of which tightly enclose, but do not quite cover the plumule. When the fruits have matured in the fall, they drop into the water, and will be found floating for a certain time, while the

pericarp either opens by gradual decay or becomes ruptured by the jelly, which, after contact with the water, swells rapidly and forms a perfectly translucid, mucilaginous coat around the seed (Plate XVII, Fig. 139), very much like the shell of a univalve mollusk, and is only to be removed from the seed with great difficulty. The germination begins while the seed is still floating upon the water, and the first sign of the young plant is the plumule breaking out through the mucilaginous envelope and separating itself from the clasping margins of the cotyledon (Plate XVII, Fig. 141). In this very first state of germination there is to be seen not only the first leaf (L^1 in Fig. 141) surrounding the plumule, the position of which is alternating with the cotyledon, but also the primary root (R in Fig. 141), which has commenced to break out. Two pairs of other roots are visible on each side of the first root, but merely as round spots, which are lighter colored than the surrounding parts of the seed. The seed now begins to sink in the water, and, while the plumule continues its growth, the roots become more distinct, partly breaking through the still persisting mucilaginous coat. It will be seen by an examination of Plate XVII, Fig. 141, in which the same seed, seen from the side and from the front, has been figured, that the primary root is the farthest developed.

Next in order are the two pairs of roots, mentioned above. The coleorhiza is distinct, but entirely smooth, as the roots themselves, without any hairs. Above these roots and at the very base of the plumule one pair of round spots is to be observed, which, as will be shown later, represent a third pair of roots, but whose development is proportionally very slow.

In following the further development of the germinating plantlet, the next state is (Plate XVII, Fig. 144) the disappearance of the jelly by gradual solution, till it forms but a thin membrane around the seed, then soon decays and disappears entirely. The first leaf now comes out and shows its final form, it being bicarinate, sheathing and scale-like. The form of this first leaf next the scutellum is characteristic of most of the Araceæ with exalbuminous seeds, while in those

with albuminous seeds the first leaf mostly has the form and structure of the normal leaves, and has a distinct petiole and blade developed. This fact has been pointed out by Engler,* but it seems, as if it had been overlooked, that the seed of our plant is exalbuminous, as Engler describes it under the tribes Peltandreae as having "Semina albuminosa."

But, besides the development of the first leaf, we see also the second one (L^2 in Fig. 144), and further, that the primary root has been almost surpassed, in regard to growth, by the lowest pair of secondary roots (r^1). The primary root, of which the direction seems to be almost horizontal in contrast to the others, which usually grow immediately downward, has now attained its final length, while the secondary roots (r^1, r^2 and ^{3} in Fig. 145) are rapidly growing out. We see further, in Fig. 145, that, besides the above-mentioned two pairs of secondary roots (r^1 and r^2), another one has been developed (r^3) below the primary one. In this same state (Fig. 145) the leaf has come out (L^2) showing the shape of the first one (L^1), but is almost twice its length, and surrounds the base of the third one (L^3), which again assumes the same form. We now have on this germinating plantlet three leaves, all of which are approximately scale-like, or at least with the blade entirely wanting, and very different from the normal, arrow-shaped leaves. There is, however, between these two forms a sort of transition, since, as shown in Figs. 147 and 148 (L^2 and L^3 which are the first leaves after the scale-like ones), they have a blade, which is ovate-lanceolate and tapering at both ends. This kind of leaves, which precede the normal ones, may appear sooner or later, *i. e.*, either following immediately upon the first scale-like leaf (l^1 in Figs. 147 and 148) or being preceded by even three of that kind, as the specimen shows (Fig. 145). The further development of the roots is shown in the Figs. 147 and 148, and we see in all four pairs of secondary roots on both sides of the front part of the young plant, and two others, the one above, the

---

* A. Engler: Araceæ in Alph. and Cas. De Candolle's Monographiae Phanerog. Prodromi, vol. II., 1879.

other one below the primary root, which is now entirely faded. The roots do not show any sign of ramification, and they are but sparingly covered with root-hairs.

It is curious to see, that the pair of roots (r^4) that are already visible in that very early state, appearing there (Fig. 143) as two round spots, have now first been developed. The space of time, that has passed since the first stage of germination (Fig. 140) to the last one (Fig. 148), is about three months, and still the scutellum is attached to the plantlet, and is not changed in any considerable degree in size or in shape.

In regard to the rhizome of the full-grown plant of *Peltandra undulata*, this does not show any essential difference from that of the young plant, shown in Fig. 148. The stem is very short, sparingly branched with ascending shoots, covered with the sheaths of the leaves and emitting numerous whitish, rather thick roots, that are but sparingly branched at their ends.

Orontium aquaticum.

This genus belongs to the tribe "Symplocarpeæ," and the fruit contains only one seed, which is exalbuminous, provided with a mucilagineous jelly, similar to that of *Peltandra.* The embryo and the testa of the seed are light green, and the germination commences immediately after the maturity of the fruits, as soon as they have dropped. Several germinating plantlets were collected in the month of June in the stage of germination, shown on Plate XVIII, Fig. 150. The cotyledon is large, roundish, and very much like that of *Peltandra*, but does not show the furrow, that embraces the plumule as in *Peltandra*, but simply a shallow cavity of irregular form.

The first leaf, alternating with the cotyledon, is nearly linear, pointed and sheathing at the base, terete, not bicarinate. It is to be especially remarked, that the primary root does not come out before the first leaf has attained its full size, and the appearance of the whole root system seems to develop very slowly in this plant. We find the same condition, as mentioned in *Peltandra*, that is, that the shape of the

first leaf is entirely different from that of the normal ones, which are long petioled with a blade broadly oblong and tapering at both ends. All the first five leaves of this plant showed the same uniform shape, and there will usually be several more developed before the typical leaf appears. The primary root does not attain any considerable length, and very soon dies off, and is then replaced by the secondary roots, as figured in Plate XVIII, Fig. 152. This figure shows a germinating plantlet about one month old, in which the cotyledon is still attached, and where the first five leaves have developed, the first two (l^1 and L^1) having partly faded. Three roots have come out besides the primary one, but none of these show any ability either of rapid growth or of any form of ramification.

Anthurium Andraeanum.

This genus belongs to the tribe Anthurieæ in which the seeds are albuminous, and where the germination shows the same general course of development, as has been described by Engler, for this group, *i. e.*, the first leaf next the cotyledon, has the same shape and structure as the normal leaves, with only a few unimportant modifications. The bright yellow fruit (Fig. 153) is a berry, of which the pericarp is very thin, almost membranaceous, and contains merely one single seed, the testa of which is also very thin.

While the fruits were still attached to the spadix, several of them had already commenced to germinate, and showed the primary root penetrating the pericarp. The embryo is green. The cotyledon is fusiform, as shown on Plate XVIII, Fig. 156, where it has been detached from the albumen. The first state of germination (Plate XVIII, Fig. 155) shows the conical primary root, covered with root-hairs, and further developed than the small, wart-like plumule, which is still enclosed by the front of the cotyledon. The next state has been represented in Fig. 156, where the primary root has grown further in length, and the plumule is visible, having penetrated the front of the cotyledon, which forms a sheath around it. The first leaf (L^1 in Fig. 157) alternates

with the cotyledon and shows a distinct sheath and blade, the form of which is cordate, sometimes ovate or even roundish in other specimens, while the final and normal form of the leaf is oblong-cordate (Fig. 164).

If we were now to follow the further development of the germinating plantlet, we would see that the primary root continues its growth without showing any tendency to ramification, and further, in Fig. 160, that the first internode has been formed and directed vertically. In this same state two more leaves have come out (L^2 and L^3), and there is also seen the beginning of the development of the fourth one (L^4). Two secondary roots have appeared, the first one (r^1) just above the primary root and at the very base of the leaf (L^1), while the other one has been developed on the middle of the first internode and in alternation with the root (r^1). There was from the very young state (Fig. 157), to the last mentioned one (Fig. 160), a period of two months. A few days after the primary root had attained its final length, and the germinating plantlet (Fig. 161) had stretched itself and obtained one more internode besides one more leaf (L^5), while the secondary root (r^2) has not yet grown out in this specimen ; but we see, on the other hand, that the primary root of this specimen has obtained a lateral branch, a case, however, which seems to be relatively rare in the specimens examined.

The further growth of the plant is already indicated, the stem being erect, consisting of several internodes of about the same length, and all provided with roots, one at each internode, and developed opposite the respective leaves. This is seen in Fig. 162, where a young plant has been drawn five months later than the last-mentioned one (Fig. 161). We see here that the seed is still attached, that the primary root still persists without fading, and that a number of secondary roots have been developed from the stem. The oldest of these secondary roots (r^1) has not attained any considerable length, and does not grow any more. The same seems to be the case in regard to r^2, while all the other ones (r^3–r^9) are growing quite rapidly, and all directed downwards to the ground, offering in that manner a good support to the ascend-

ing or almost erect young stem. The roots are all densely covered with root-hairs and unbranched. The leaves are now considerably larger than in the state last described, but the blade has not yet, however, assumed the normal shape, which has been figured on Plate XIX, Fig. 164. The plant continues its growth, as indicated (Fig. 162), and the whole stem is entirely above ground without any proper rhizome.

ALISMACEÆ.

Alisma Plantago, var. *Americana.*

The germination of the seed of this variety is the same as that of the typical form, which has been so exactly figured by Mirbel.*

The cotyledon is a relatively long, terete leaf, which carries the testa of the seed at its summit for some time, and is entirely above ground. A germinating plantlet is shown on Plate XIX, Fig. 166, where the plumule (P) has not yet come out, but is still to be found inside the base of the long cotyledon, that shows an incipient swelling at the place where the plumule has to penetrate. There is between the base of the cotyledon and the primary root a cylindrical body (C), which is the hypocotyl, and we further see a distinct roll at the transition from the stem to the root, which is densely covered with hairs, and which Mirbel has explained as a rudimentary coleorhiza. The primary root (R) is very short and is not further developed, and is replaced by secondary roots, of which the first one will come out at the base of the cotyledon, just below the plumule, while the other parts of the seedling, the hypocotyl, the rudimentary coleorhiza and the primary root disappear very early.

CONCLUDING REMARKS.

It is merely a matter of incident that has caused just the above-mentioned species to have been described from their

* Brisseau-Mirbel. Elémèns de Physiologie végétale et de Botanique, 1815, Pl. 61.

earliest stage as germinating plantlets until they have attained an older state, or even full-grown age. It was a collection of material that was in the hands of the author, and it was thought the opportunity ought not to be neglected to present these contributions to the knowledge of the germination of some of our native plants. And even if several other species might have shown facts of greater interest than those described here, we must recall the fact that the number of plants taken from our flora, that have been described from their germination, is exceedingly small. The whole series of germinating plantlets, presented above, show several characters, so that genera and species of the same family are to be distinguished from each other in their very earliest stage. We see for instance, *Anemone thalictroides* differing from most of the other species of this genus by its tuberous roots, which are already developed in the first year. The two species of *Ranunculus*, *R. abortivus* and *R. recurvatus* differ from each other by the shape of the cotyledons, short or long-petioled, and by the form of the first leaf. *Delphinium nudicaule* shows a relatively rare manner of germination in comparison with other species of that genus. The germinating plantlets of *Sarracenia* and *Dionæa* are so characteristic that they might easily be distinguished from any other plants, when merely the first leaf is visible. There is probably no genus of the Papaveraceæ which germinates in the same manner as shown for *Sanguinaria*, with the cotyledons deeply under ground, and with a tuberous hypocotyl. *Viola palmata*, var. *cucullata*, has some relatives in regard to the development of the young rhizome, but is, however, different from most of the other species of *Viola*. The two species of *Lespedeza* are easily distinguished from each other by the foliage alone during the germination. And even among the Umbelliferæ some characters are to be observed that enable us to distinguish them at that early stage. The two species of *Thaspium* differ in the shape of their first developed leaves; *Osmorrhiza* is characterized at an early stage by its dimorphous leaves, and *Sanicula* by the early fading of the primary root, together with its relatively broad cotyledons. *Aralia*

further shows the peculiar fact, that the cotyledons are unequal as well as different in shape. In regard to the monocotyledonous plants we are also able to find among them some characteristic differences, the long, terete, leaf-like and free cotyledon of *Agave* in contrast to the short, conical cotyledon of *Yucca*, which is enclosed in the seed. The distinct epicotyl, observed in *Smilax*, *Anthurium*, etc., and the development of the bud in the axil of the cotyledon in the first genus. And if we consider the Araceæ, we shall find, for instance, as pointed out by Engler (l. c.), that the final leaves are most often preceded by scale-like ones in the species with exalbuminous seed, as shown in *Peltandra*, *Orontium* and *Aglaonema* (Fig. 165), in contrast with *Anthurium*, where the albuminous seed develops a plan t of which the first leaf has a distinct blade, petiole and sheath.

These germinating plantlets show also, in several respects, that the earliest stage of the plant, or what we call "the germinating plantlet," gives a figure in a small scale of the full-grown plant. Turning to some of the more interesting facts described above, we shall take for instance the case of cotyledons with connate petioles as in *Delphinium nudicaule*. This peculiar fact was discovered several years ago, and is mentioned by Bernhardi in a paper entitled: Ueber die merkwurdigsten Verschiedenheiten des entwickelten Pflanzen Embryo und ihrem Werth für Systematik.* The author enumerates there several plants that he has found germinating in this manner, namely: "many," Umbelliferæ, for instance, *Ferulago sp.*, *Bunium luteum* and *Prangos ferulacea*, further "many," *Delphinieæ; D. fissum*, *D. ochroleucum* and partly *D. puniceum*, *Dodecatheon Meadia* of the Primulaceae and finally *Leontice Altaica* and *L. vesicaria* of the Berberideæ.

Another author who has observed the same fact is A. Winkler in his paper, "Ueber die Keimblætter der deutschen Dicotylen,† where he calls the attention to the same manner

* Linnaea, Vol. VII, 1832, page 561.

† Verhandlungen d. bot. Vereins d. Provinz. Brandenburg. Vol. XVI. 1874.

of germination in *Polygonum Bistorta*, and evidently, also, *P. viviparum*, further *Anemone alpina* and *A. narcissiflora*, while in some species of *Dentaria*, *Chærophyllum bulbosum*, *Eranthis hiemalis* and *Aconitum Anthora*, the plumule does not attain any further development the first year, but grows out during the next year after the cotyledons and the cotyledonar tube have faded away entirely. Asa Gray has also given some contributions in his paper : The germination of the genus *Megarrhiza*, Torr,* where he has described some germinating plantlets of *M. Californica*, and mentions the same case as characteristic of *Delphinium nudicaule*. Furthermore Dickson† has observed, that *Anemone coronaria* and *Podophyllum Emodi* germinate in the same manner, while Lubbock‡ has given some remarks upon *Polygonum polystachyum*, of which the germination differs a little from the above mentioned, as the plumule does not break through the base of the cotyledonar tube, but passes through it, so that the seedling has the appearance of possessing an erect hypocotyl with nearly sessile cotyledons. Figs. 79 and 80, on Plate XI, represent two germinating plantlets of *Rheum Moorcroftianum* which were cultivated in the U. S. Botanical Garden, and that showed the same fact mentioned above, that the petioles of the cotyledons form a long tube, and where the plumule becomes visible through a slit at the base of it. Several specimens were examined, and this seems to be the normal condition also of this plant. The tube was cylindrical, and a transverse section showed the presence of only four fibro-vascular bundles, while two groups of a collenchymatic tissue were to be observed in the place where the petioles had been united. Fig. 81 represents a section of half of the tube.

We have then seen that this manner of germination is the

---

* Silliman's Journal of Science, Vol. XIV, 1877.

† Dickson : On the Germination of *Podophyllum Emodi*. Transact. of Bot. Soc. of Edinburgh, Vol. XVI.

‡ Sir John Lubbock : Phytobiological Observations, Journal of Linn. Society, Vol. XXIV, No. 159, 1887.

normal one in several plants, especially in some Ranunculaceæ, Berberideæ, Umbelliferæ, and Polygonaceæ, while it may occasionally occur as an abnormal condition in some others, as for instance in *Ricinus*, where it has been observed by Magnus.*

If we now turn to the germination of *Ipomaea paniculata* (Plate XI, Fig. 76), we see that the plumule is there situated at the summit of a large root, and between two very long-petioled cotyledons, just as it has been observed, for example, in several Umbelliferæ. It is relatively the same case, as observed in *Delphinium nudicaule*, with the exception that the petioles are free, while the plumule, notwithstanding that it is protected in the same manner, is kept well underground and protected against severe cold and draught. This occurrence in some species of *Ipomoea* has been mentioned by Gray in his "Notulae exiguae," † where he has described the same manner of germination in *I. leptophylla*, *I. pandurata* and *I. Jalapa*, all of which are large-rooted species. There was, however, one germinating plantlet of *I. paniculata* (Fig. 77) which showed four cotyledons, of which two were grown together with their petioles and blades, whereas the other pair were perfectly free. The plumule was situated close to the base of the furrow, formed by the connate petioles (Fig. 78), and this fact might lead to the conclusion, that the cotyledonar tube probably has existed or still exists also in this genus.

In contrast to these cases, where the plumule is kept underground, or at least close to its surface, we have seen, in most of the other dicotyledoneous seedlings examined, that a distinct hypocotyl has been developed. This might seem to be rather injurious to the plant, as the plumule does not receive any further protection, and the hypocotyl is ordinarily not strongly developed, is neither thick nor possesses any mechanical tissue. But it must then be remem-

* P. Magnus: Ueber zwei monstrose Keimpflanzen von *Ricinus*. Verhandl. d. Bot. Vereins d. Provinz Brandenburg. Vol. XVIII, p. 107.

† Botanical Gazette, Vol. V, p. 87, 1880.

bered that in some cases it is of great importance to the young plant that the plumule should be kept free from the surrounding plants, so as to be more exposed to the air and light. And we have seen, for instance, in the germinating plantlets of *Ranunculus abortivus*, *R. recurvatus*, *Sarracenia*, *Saxifraga* and *Sanicula*, how the hypocotyl gradually is forced to bend down to the ground, after the first leaves have developed. The plant attains the same protection as *Ipomœa* and *Delphinium*, only at a later stage, and it is well attached to the ground by the development of roots from the upper part of the hypocotyl in connection with the more or less persistent primary root and the earlier developed secondary ones. It is to be supposed that this manner of germinating, with the rooting hypocotyl and the primary root dying away, is far from rare among the perennial herbs with short, tufted rhizomes. Another manner in which the young plant can be kept near the surface of the ground is by the roots as mentioned under *Hemerocallis* and *Eucharis*, where the roots show a distinct wrinkling, depending on their ability to contract, and this fact is also observed in several other monocotyledonous plants, as well as among the Dicotyledoneæ.

In regard to the shape of the cotyledons there is quite a considerable difference, but the case of *Aralia spinosa* with unequal cotyledons seems to be very rare. A similar case has, however, been observed by Lubbock,* who has described the germination of *Petiveria octandra*. The cotyledons were different in size, and of a very different shape, one being oblong, tapering at both ends and entire, while the other one was subcordate and three-lobed.

If we consider the figures, illustrating the germination of the monocotyledonous plants (Plate XIII to Plate XIX), we shall see that the germination is very uniform, although it shows a few differences. The shape of the single cotyledon is different, depending on the seed being albuminous or exalbuminous. In the first case, it may be perfectly leaf-like, as *Agave* and *Alisma*, or the superior part of the blade may be

---

* Sir John Lubbock: Phytobiological Observations. Journal of Linn. Society, Vol. XXII, 1887, p. 371.

transformed into a spongious body, closely imbedded in the albumen, while the lower part is free, as for instance in the Palmae, *Smilax* and *Yucca ;* or the cotyledon can be entirely enclosed in the seed, showing a more or less shield-like, conical or fusiform shape, as, for example, in *Carludovica*, *Eucharis*, *Hemerocallis* and *Anthurium*. On the contrary, in plants with exalbuminous seeds, the cotyledon forms a more or less roundish body, as in *Peltandra*, *Orontium* and *Aglaonema*. The sheath, formed by the base of the cotyledon, and opens with a slit on the anterior face, has been observed in all the species with albuminous seeds, but not in the other ones, *Peltandra*, *Orontium* and *Aglaonema*. The first leaf next the cotyledon is mostly scale-like, and is, at least in the species described above, in constant alternation with the cotyledon, like the epiblast of the Gramineæ.

The presence of a hypocotyl has been observed in *Smilax* and *Agave*, and a distinct epicotyl was found in *Smilax*, *Carludovica* and *Anthurium*.

The primary root does not always fade away as soon as is usually described as characteristic of the Monocotyledoneæ, and we have seen several cases of a rather strong development, and of a considerably long duration in *Attalea*, *Yucca* and *Anthurium*.

U. S. National Museum, Washington. June, 1890.

EXPLANATION OF THE ABBREVIATIONS USED IN THE PLATES.

B, ... Bud.
Br. . . . . Branch.
C. . . . . . Hypocotyl.
Cot. . . . Cotyledon.
E. . . . . . Epicotyl.
F. . . . . . Flowering Stems.
Fr. . . . . Fruit.
L. . . . . . Final Leaf.
L'. . . . . . Scale-like Leaf.
Pl . . . . . Plumule.
pr. . . . Prophyllum.
R . . . . Primary root.
r. . . . . Secondary root.
S. . . . . Shoot.
Sd. . . . Seed.
Sh. . . . Sheath.
Sl. . . . . Slit.
St. . . . . Stem.
T. . . . . Tube.

EXPLANATION OF PLATES.

(Figures all drawn from nature by the Author.)

PLATE V.

Anemone thalictroides.

Fig. 1. A germinating planflet, nat. size.
2. A cotyledon, 5 × nat. size.
3. A young plant, shortly after the cotyledons have dropped, nat. size.
4. A plant, one year old, nat. size.
5. The rhizome of the full-grown plant, nat. size.

Thalictrum dioicum.

Fig. 6. A germinating plantlet, nat. size.
7. A germinating plantlet, showing the distinct hypocotyl, nat. size.
8. The rhizome and the lower part of the stem of an older specimen, nat. size.
9. The rhizome of a full-grown plant, nat. size.

Ranunculus abortivus.

Fig. 10. A germinating plantlet, 3 × nat. size.
11. The same, a little older, 3 × nat. size.

PLATE VI.

Ranunculus abortivus (continued).

Fig. 12. A germinating plantlet, a little older than Figs. 10 and 11, 3 × nat. size.
13. An older stage of the same, 3 × nat. size.
14. A young plant, from which the cotyledons have dropped, and of which the hypocotyl and the primary root have commenced to fade away, 2 × nat. size.

Fig. 15. The rhizome of a full-grown plant with the leaves and the bases of two flowering stems, nat. size.

Ranunculus recurvatus.

Fig. 16. A germinating plantlet, 3 × nat. size.

Delphinium nudicaule.

Fig. 17. A germinating plantlet, side view, nat. size.
18. The same, front view, nat. size.
19. The blades of the two cotyledons, $1\frac{2}{3}$ × nat. size.
20 The blade of a cotyledon from the specimen Fig. 18. $1\frac{2}{3}$ × nat. size.
21. The blades of three cotyledons, $1\frac{2}{3}$ × nat. size.

PLATE VII.

Delphinium nudicaule (continued).

Fig. 22. An older specimen with the cotyledons still persisting, nat. size.

Sarracenia purpurea.

Fig. 23. A germinating plantlet with the testa of the seed still attached, 6 × nat. size.
24. The same, a little older with the cotyledons free and spread out, 6 × nat. size.
25. The same with the first pitcher-shaped leaf developed, 6 × nat. size.
26. A young plant with the cotyledons still attached, and with several pitcher shaped leaves developed, 3 × nat. size.
27. The first developed pitcher-shaped leaf, 6 × nat. size.

Sanguinaria Canadensis.

28. A germinating plantlet, nat. size.
29. One of the cotyledons, 5 × nat. size.
30. A germinating plantlet with two leaves developed next the cotyledons, nat. size.

PLATE VIII.

Sanguinaria Canadensis (continued).

Fig. 31 and 32. Two germinating plantlets with the cotyledons dropped, nat. size.
33 and 34. Two plants, one year old, showing the scale-like leaves preceding the final one and the tuber, formed by the hypocotyl, nat. size.
35. The rhizome of a full-grown plant, nat. size.
36. A lateral shoot from an old rhizome, nat. size.

Viola palmata, var. *cucullata.*

Fig. 37. A germinating plantlet, 2 × nat. size.
38. The rhizome of a young plant, with the cotyledons dropped, 2 × nat. size.
39. The rhizome of an older, flowering plant, 2 × nat. size.

PLATE IX.

Viola palmata var. *cucullata* (continued).

Fig. 40. A young plant, showing the swelling of the hypocotyl, 2 × nat. size.
41. A young plant with the cotyledons still attached, 3 × nat. size.
42. A leaf with the swollen base, nat. size.

Lespedeza violacea.

Fig. 43. A germinating plantlet, nat. size.
„ 44. The rhizome of a full-grown plant, nat. size.

Lespedeza procumbens.

Fig. 45. A germinating plantlet, nat. size.
46. The rhizome of a full-grown plant, nat. size.

Clitoria Mariana.

Fig. 47. A germinating plantlet, nat. size.
48. One of the cotyledons, nat. size.

PLATE X.

Clitoria Mariana (continued).

Fig. 49. The rhizome of a full-grown plant, nat. size.

Cassia Chamaecrista.

Fig. 50. A germinating plantlet, 2 × nat. size.

Rubus hispidus.

Fig. 51. A germinating plantlet, nat. size.
52. A young plant, one year old, nat. size.

Potentilla Canadensis.

Fig. 53. A germinating plantlet, nat size.
54. The rhizome of a full-grown plant, nat. size.

Saxifraga Virginiensis.

Fig. 55. A germinating plantlet, 6 × nat. size.
56. The same, a little older, 6 × nat. size.
57. A young plant with the cotyledons, still attached, and several leaves developed, 6 × nat. size.
58. A young plant, 3 × nat. size.
59. A stellate hair from one of the first developed leaves, highly magnified.

Dionaea muscipula.

Fig. 60. A germinating plantlet with the cotyledons still enclosed in the seed, 4 × nat. size.

Fig. 61. The same, a few days older, with the cotyledons free, 4 × nat. size.

PLATE XI.

Dionaea muscipula (continued).

Fig. 62. A young plant, showing the first leaves next the cotyledons, 4 × nat. size.

63. The same, a little older, with the first secondary root visible, 6 × nat. size.

64. The rhizome of an old plant, 2 × nat. size.

65. The same, longitudinal section, 2 × nat. size.

Thaspium barbinode.

Fig. 66. A germinating plantlet, nat. size.

67. A germinating plantlet with three cotyledons, nat. size.

68. A young plant with the cotyledons dropped, nat. size.

Thaspium aureum.

Fig. 69. A germinating plantlet, nat. size.

Osmorrhiza longistylis.

Fig. 70. A germinating plantlet, 2 × nat. size.

71. A young plant, one year old, showing a leaf, different from the first one figured in Fig. 70, nat. size.

Sanicula Marylandica.

Fig. 72. One of the cotyledons, 4 × nat. size.

73. A germinating plantlet, 2 × nat. size.

74. A young plant, showing the strongly developed secondary roots, nat. size.

Aralia spinosa.

Fig. 75. A germinating plantlet, 3 × nat. size.

PLATE XII.

Ipomœa paniculata.

Fig. 76. A germinating plantlet, nat. size.

77. A germinating plantlet with four cotyledons, the two of which have grown together, nat. size.

78. The base of the petioles of the four cotyledons with the plumule and the upper part of the root, nat. size.

Rheum Moorcroftianum.

Fig. 79. A germinating plantlet, showing the cotyledons with connate petioles, forming a tube, through the base of which the plumule has come out, side view, nat. size.

Fig. 80. The same, front view, showing the slit in the lower part of the tube, nat. size.

81. Transverse section of the half of the tube, highly magnified.

Pilea pumila.

Fig. 82. A germinating plantlet. Nat. size.

83. One of the second pair of leaves next the cotyledons. Nat. size.

PLATE XIII.

Sabal Palmetto.

Fig. 84. The first stage of the germination with a longitudinal section, nat. size.

85. The same, a little older, nat. size.

86. A young plant, where the cotyledon has dropped, and the first leaves have developed, nat. size.

Nannorrhops Ritchieana.

Fig. 87. A germinating plantlet in the first stage, longitudinal section, nat. size.

88. The same, a little older, $\times$ nat. size.

89. An older germinating plantlet, where the plumule has commenced to break through, nat. size.

90. A young plant with two leaves developed, and with the fruit still attached, nat. size.

91. The same, but older, where the primary root has ceased to grow, and the first secondary root has come out, nat. size.

Attalea excelsa.

Fig. 92. The fruit with the germinating seed, nat. size.

93. The same, longitudinal section, nat. size.

94. A germinating plantlet, where the first leaf is visible, the fruit is still attached, nat. size.

95. A young plant, where the fruit has dropped, and the first final leaf has been developed, nat. size.

PLATE XIV.

Carludovica palmata.

Fig. 96. A germinating plantlet with the cotyledon free; two leaves are developed, nat. 5 $\times$ size.

97. The same, a little older, with the cotyledon enclosed in the seed, 5 $\times$ nat. size.

98. The same still more advanced, showing the first secondary root and four leaves; the seed is still attached, 5 $\times$ nat. size.

99. A young plant, of which the primary root has stopped its growth, while two secondary ones have come out, 5 $\times$ nat. size.

Agave univittata.

Fig. 100. A germinating plantlet, of which the cotyledon is bent, and the seed attached, nat. size.

101. The same, a little older, nat. size.

102. The same, with the seed dropped, and the cotyledon free and straight. A longitudinal slit is to be seen at the base of the cotyledon for the penetration of the plumule, nat. size.

Eucharis candida.

Fig. 103. The first stage of the germinating plantlet, where the plumule is not yet visible, nat. size.

104. A young plant with the cotyledon free ; the first leaf has developed and a secondary root has come out, nat. size.

PLATE XV.

Smilax rotundifolia.

Fig. 105. A germinating plantlet, with the fruit attached, nat. size.

106. Part of the same, showing the cotyledon, the epicotyl, the hypocotyl and the first leaf, 5 × nat. size.

107. The same, with the sheath of the cotyledon laid open to show the bud in the axil of the cotyledon, 5 × nat. size.

108. The lower part of an older specimen, where the fruit has dropped, and the first secondary root has developed, 3 × nat. size.

109. The same, with the sheath of the cotyledon removed to show the bud in the axil of the cotyledon, 3 × nat. size.

110. A young plant, where a secondary branch has developed from the axil of the cotyledon, nat. size.

111. The base of a young plant, where a tuber has developed from the axil of the cotyledon, 2 × nat. size.

112. The rhizome of a full grown plant, nat. size.

113-120. Leaves of different forms from young plants, nat. size.

121. A leaf of a full-grown plant, showing the typical form, nat. size.

122. A leaf of a full-grown plant, the form of which is very common, but not typical, nat. size.

Smilax glauca.

Fig. 123. A germinating plantlet, nat. size.

PLATE XVI.

Smilax glauca (continued).

Fig. 124. The rhizome of a younger plant, showing one tuber, 2 × nat. size.

125. The same, 2 × nat. size.

126. The rhizome of an older plant with three tubers, 2 x nat. size.

127. Tuberiferous stolons of a full grown plant, nat. size.

Hemerocallis fulva.

Fig. 128. A germinating plantlet, 3 × nat. size.
129. A young plant, where the seed and the cotyledon have dropped ; the first secondary root has been developed, 3 × nat. size.

Yucca gloriosa.

Fig. 130. A germinating plantlet with the seed attached, nat. size.
131. Part of the same, longitudinal section, showing the upper part of the cotyledon, enclosed in the albumen, 3 × nat. size.
132. An older stage of the germination, nat. size.
133. A germinating plantlet, showing the first appearance of the plumule, nat. size.
134. The same, a little older, where the first leaf has developed, nat. size.

PLATE XVII.

Yucca gloriosa (continued).

Fig. 135. An older stage, where the cotyledon commences to fade away, nat. size.
136. A young plant with the sheath of the cotyledon still persistent, nat. size.
137. A young plant, showing the development of six leaves and three secondary roots, while the primary root has faded away, only leaving a scar, R in the figure, nat. size.

Peltandra undulata.

Fig. 138. The fruit, nat. size.
139. The seed, surrounded by the jelly, nat. size.
140. The first stage of the germination ; the testa of the seed has been removed, nat. size.
141. The same more advanced, front and side view : the plumule and some roots are visible, nat. size.
142. A germinating plantlet, side view ; the plumule, the primary root and two secondary roots are visible, nat. size.
143. The same, front view, nat. size.
144. A germinating plantlet, where the second leaf begins to come out, nat. size.
145. The same (side view), a little older, where the primary root has faded away ; three leaves and three secondary roots are visible, nat. size.
146. The same, front view, nat. size.

PLATE XVIII.

Peltandra undulata (continued).

Fig. 147. A young plant, showing the development of the leaves and roots side view ; the cotyledon still attached, nat. size.
148. The same, a little older, nat. size.

Fig. 149. Diagram, showing the position of the roots.

Orontium aquaticum

Fig. 150. A germinating plantlet, showing the primary root and three leaves, front view, nat. size.

151. The same, a little older, side view, nat. size.

152. A young plant with five leaves and four roots developed ; the cotyledon is still attached.

Anthurium Andraeanum.

Fig. 153. The fruit, 3 × nat. size.

154. The seed, 5 × nat. sixe.

155. The first stage of the germination, 5 × nat. size.

156. A germinating plantlet, showing the cotyledon, the plumule and the primary root, 6 × nat. size.

157. A germinating plantlet, a little older, where the cotyledon is enclosed in the seed, and where the first leaf has been developed, 6 × nat. size.

158. The first developed leaf, magnified.

PLATE XIX.

Anthurium Andraeanum (continued).

Fig. 159. A germinating plantlet, where the secondary leaf is visible, 6 × nat. size.

160. A young plant, showing the development of the first internode and four leaves ; two secondary roots have come out, 3 × nat. size.

161. The same, a little older, showing the second internode. The seed is still attached, 3 × nat. size.

162. A young plant, five months older than the one in Fig. 161. The seed is still attached, the primary root still persists and several secondary roots have developed from the internodes of the stem, 2 × nat. size.

163. The leaf "L 8" from Fig. 162.

164. A typical leaf, taken from a full-grown plant, ⅙ nat. size.

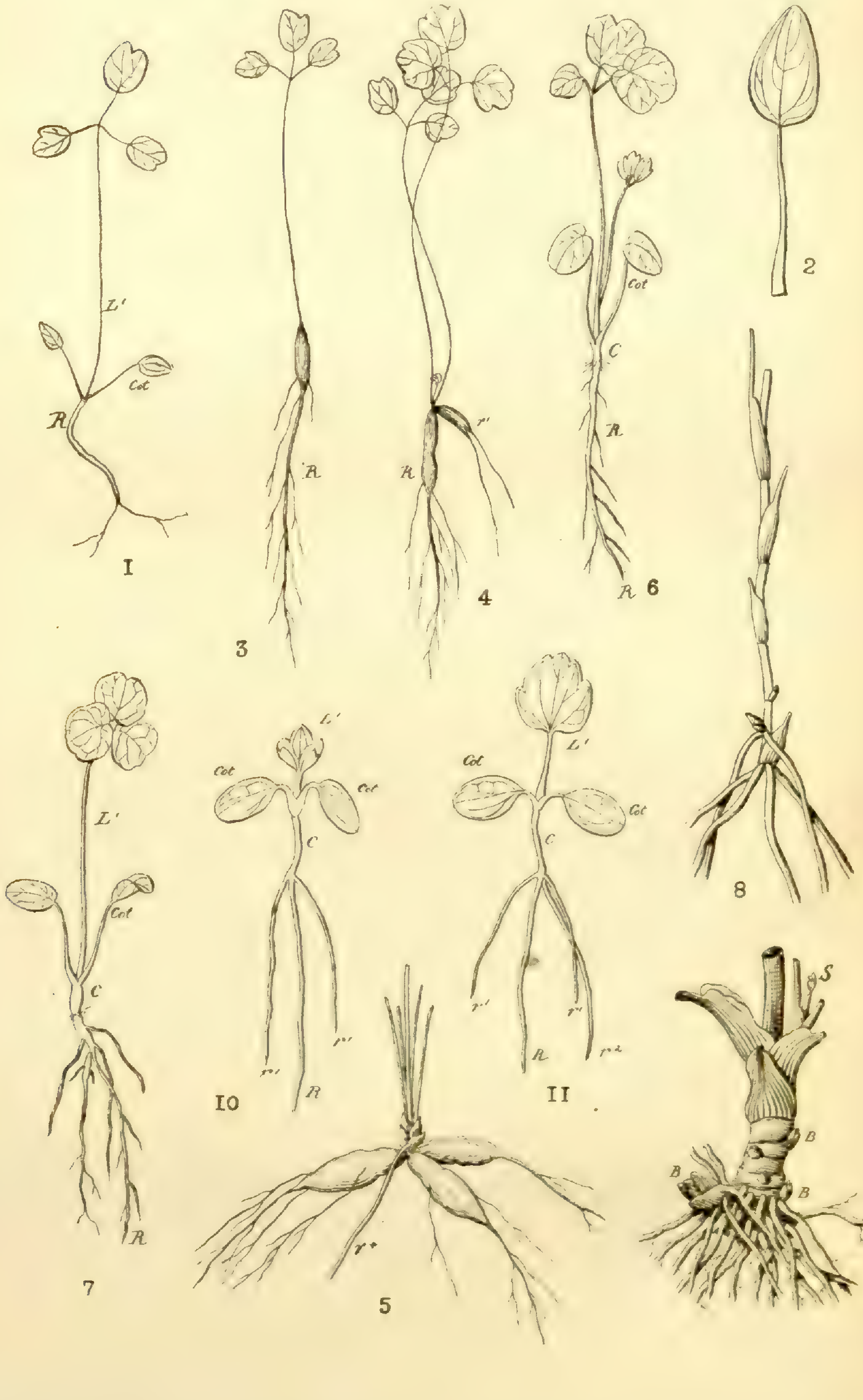
Aglaonema pictum.

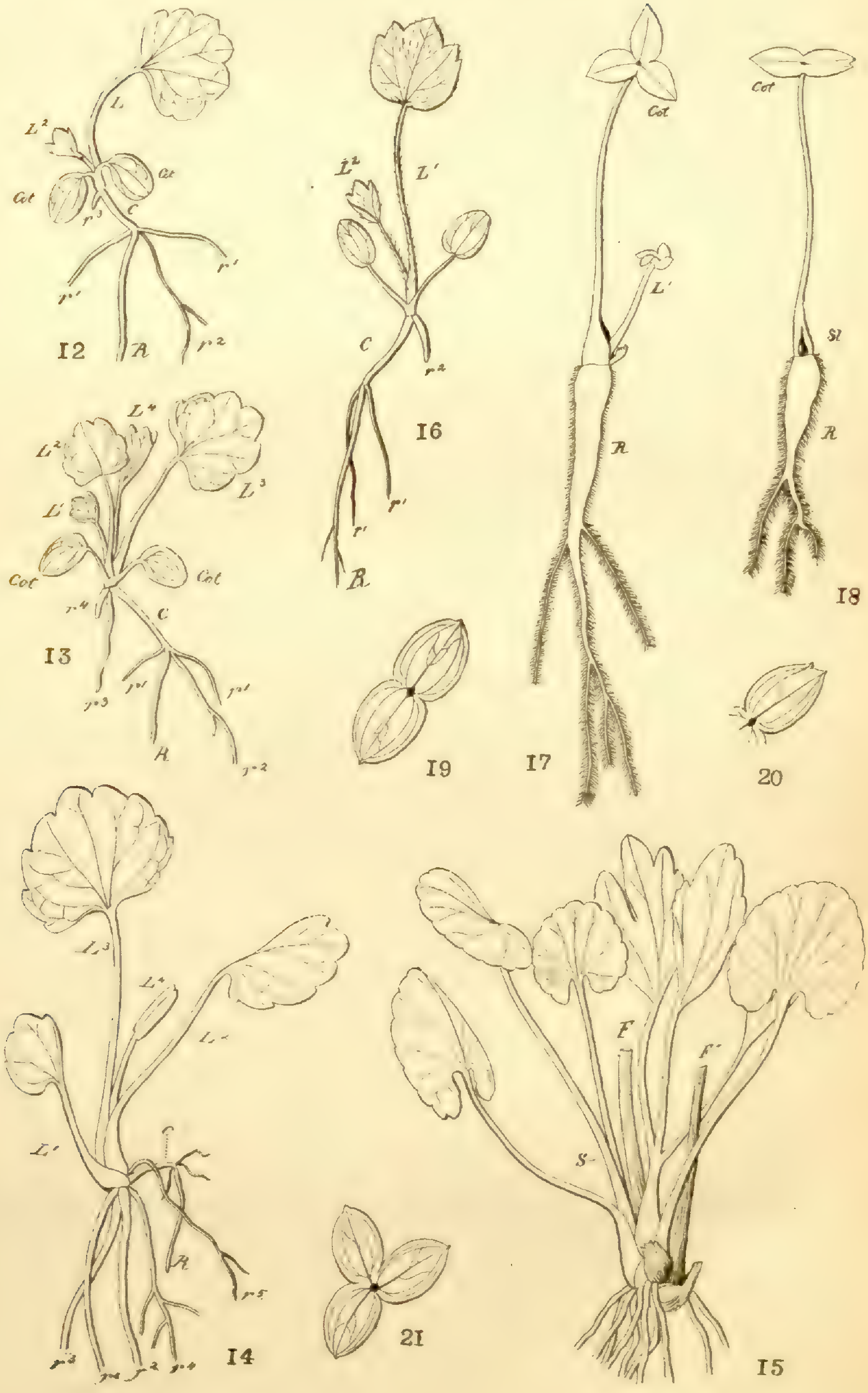
Fig. 165. A germinating plantlet, showing three scale-like leaves, 2 × nat. size.

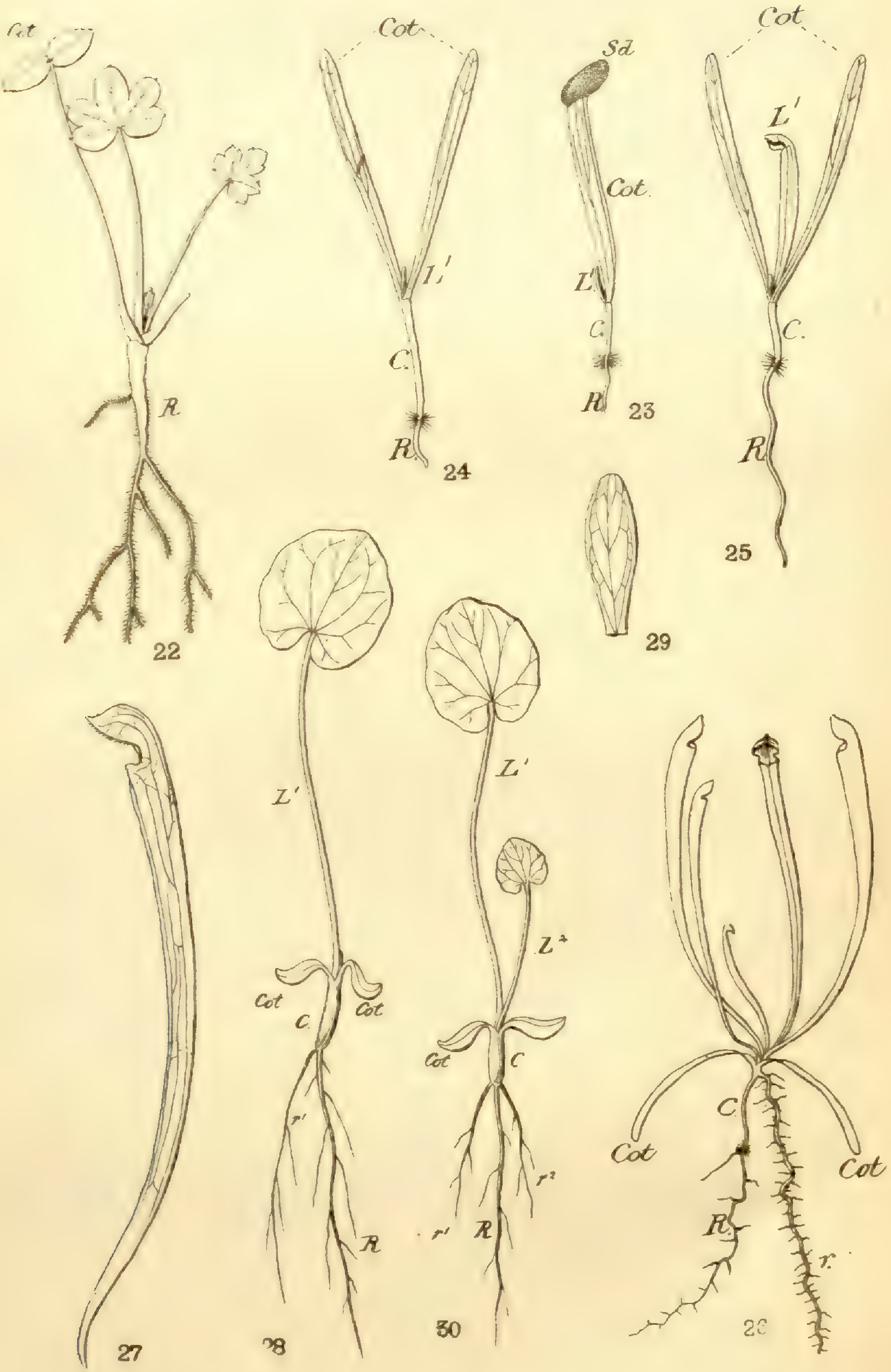
Alisma Plantago var. *Americana.*

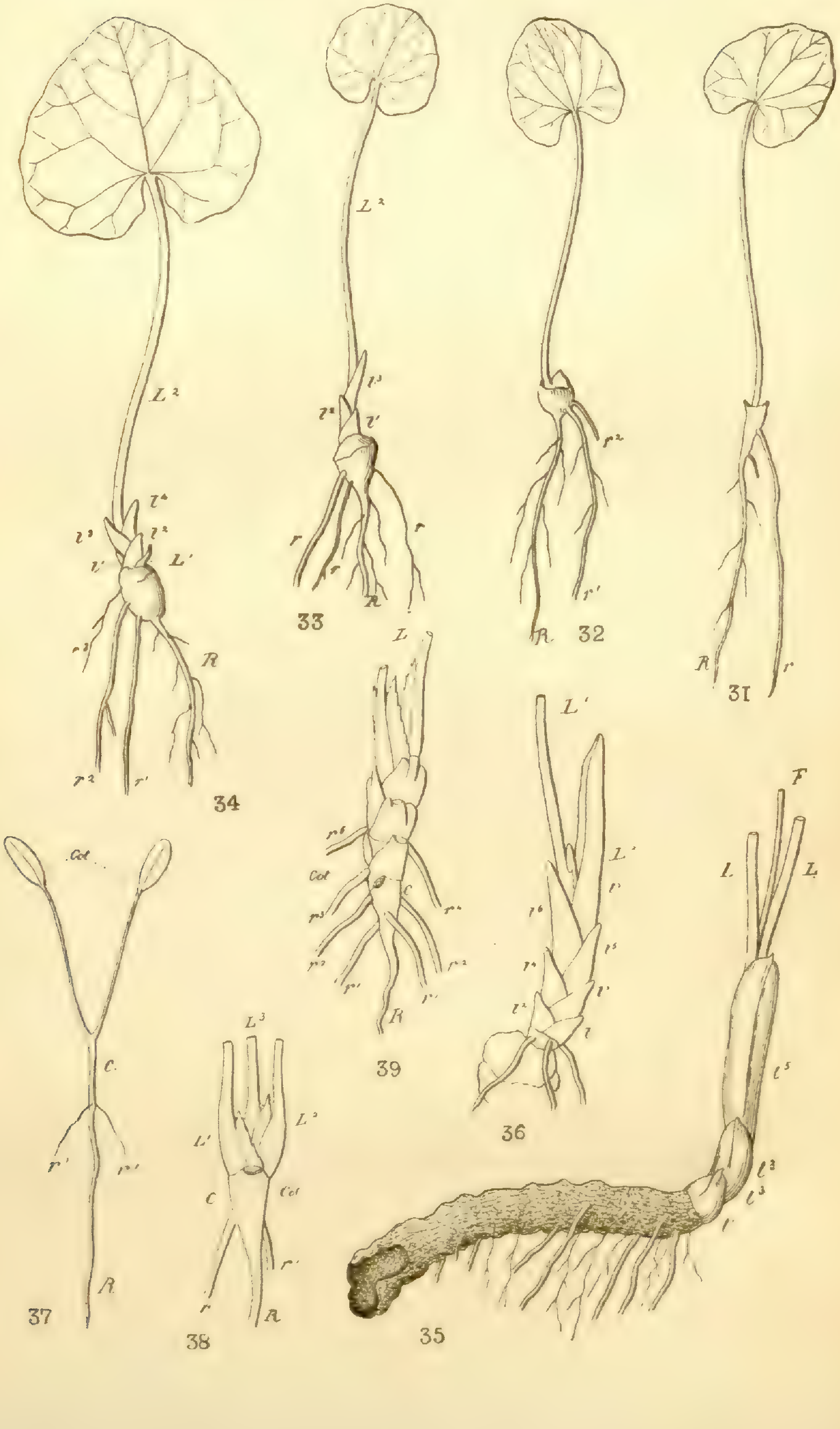
Fig. 166. A germinating plantlet, showing the long, terete cotyledon and the primary root, 8 × nat. size.

167. The same, a little older, where the plumule is visible, 8 × nat. size.



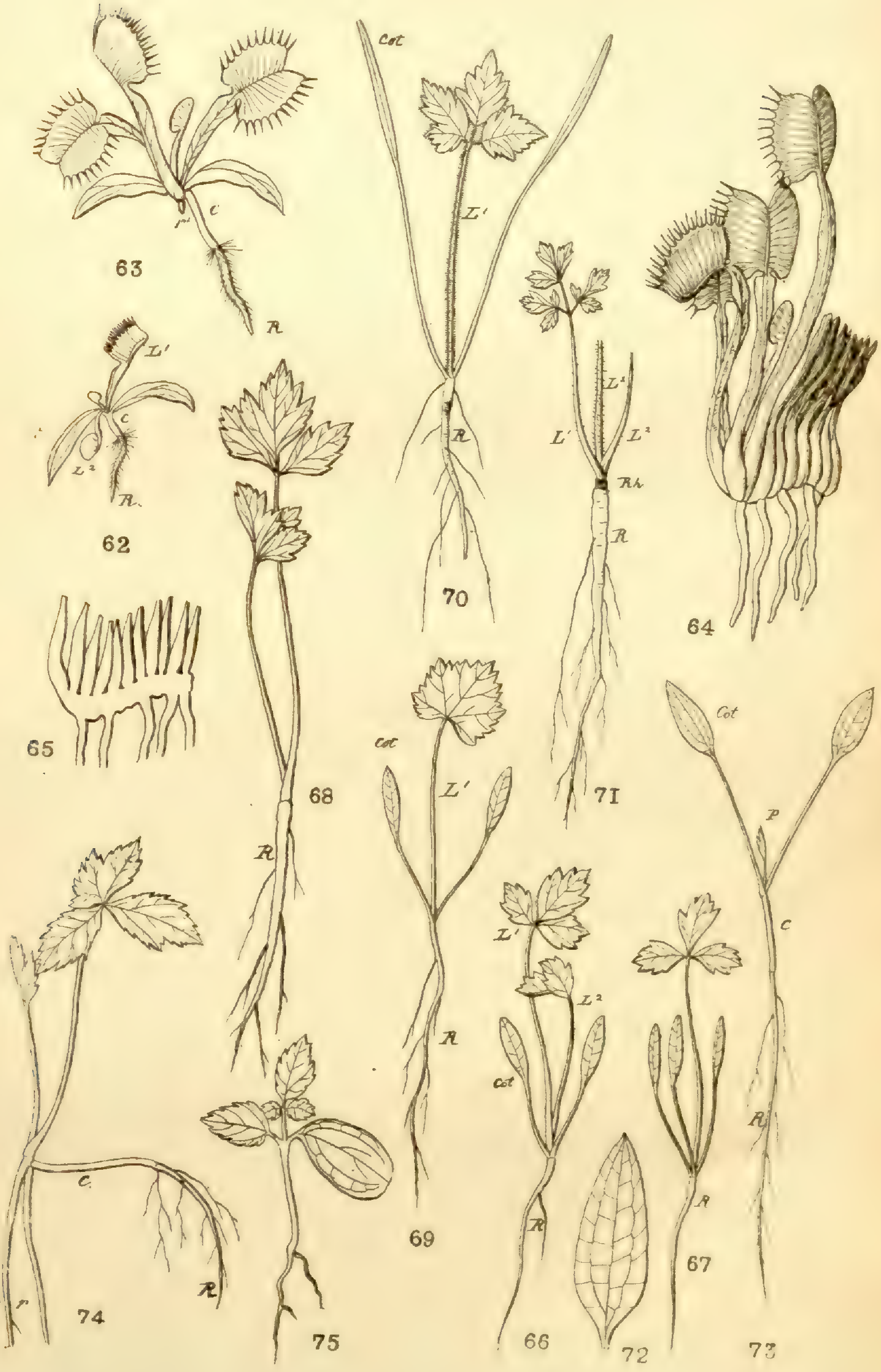

12
16
17
18
13
19
20
14
21
15

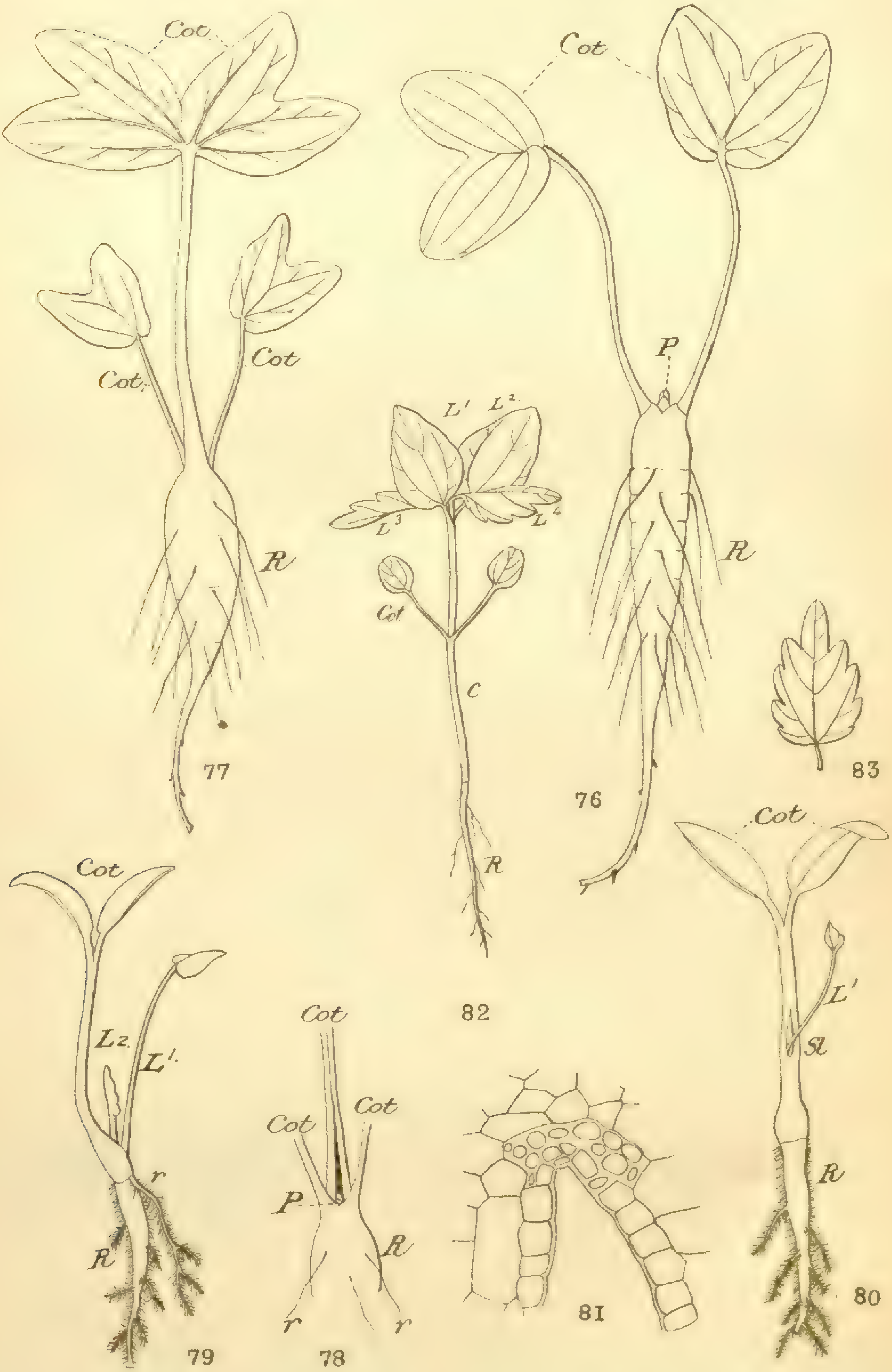

Cot
R
22
Cot
L'
C.
R.
24
Sd
Cot.
L'
C.
R
23
Cot
L'
C.
R
25
29
L'
Cot
C.
Cot
r'
R
L'
L²
Cot
C
r'
R
r²
Cot
C.
Cot
R.
r.
27
28
30


33
32
31
34
39
36
37
38
35

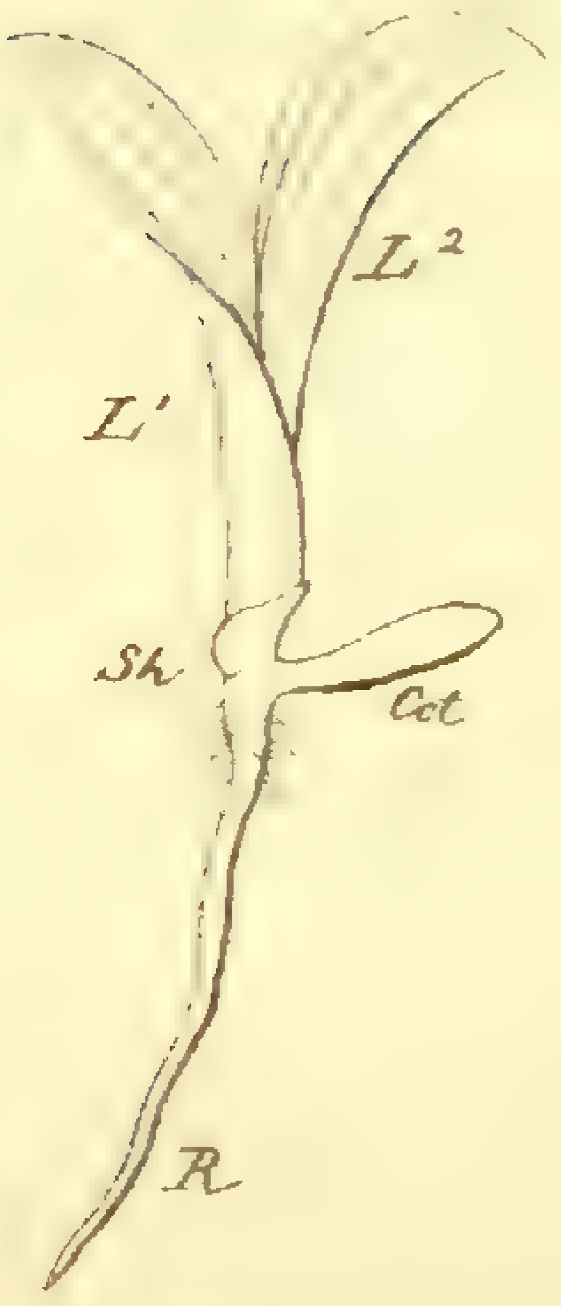
40
41
42
43
44
45
46
47
48

59
L³
L²
L'
Cot
C
R
54
R
49
R
L'
L²
Cot
P
C
R
R
61
51
50
C'
Sd
R
60
L'
Cot
Cot
56
R
R
57
L²
L³
L'
L'
C
Cot
C
R
53
R
55
C
58
St'
St²
R
52

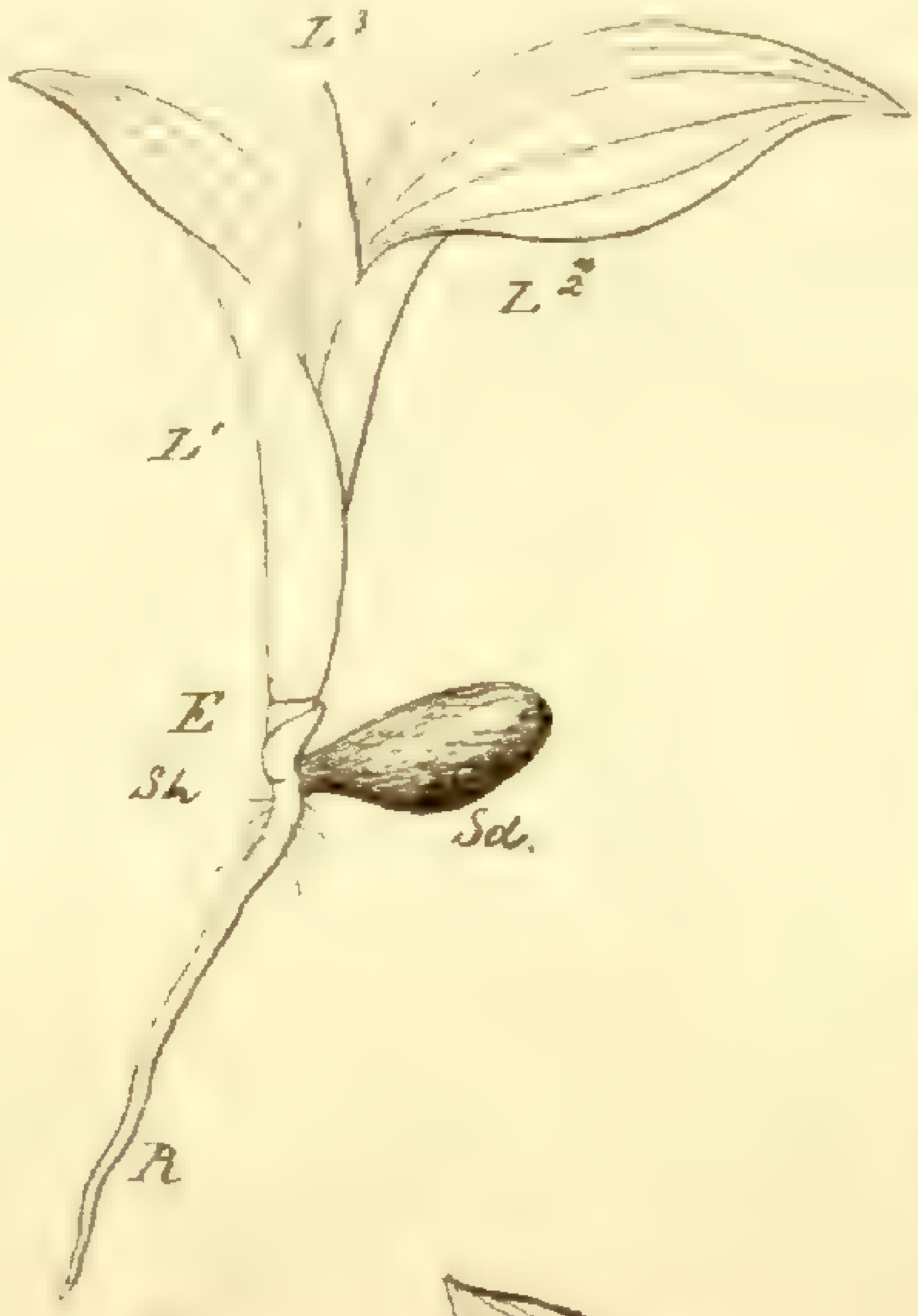

63
62
65
68
70
71
64
69
66
67
72
73
74
75


Cot
Cot
Cot
Cot
R
77
Cot
Cot
P
R
76
L' L²
L³
L⁴
Cot
C
R
82
83
Cot
Cot
L2
L'
r
R
79
Cot
Cot
Cot
P
R
r
r
78
81
Cot
L'
Sl
R
80

91
86
90
89
95
84
94
8.
92
93
87
88

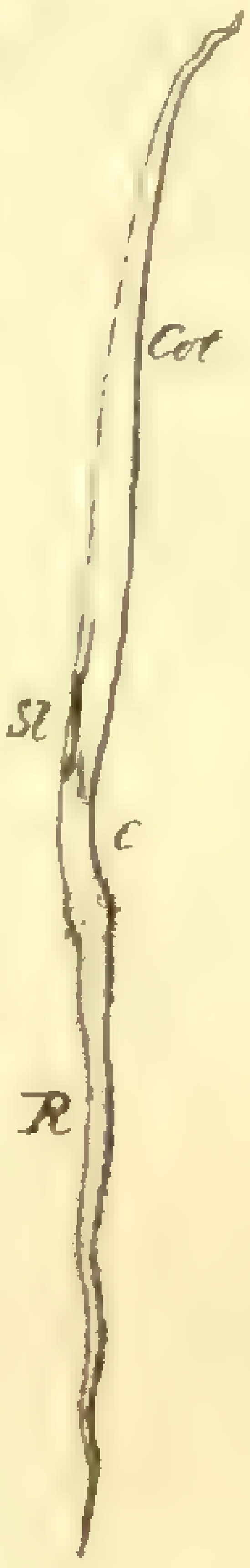


96

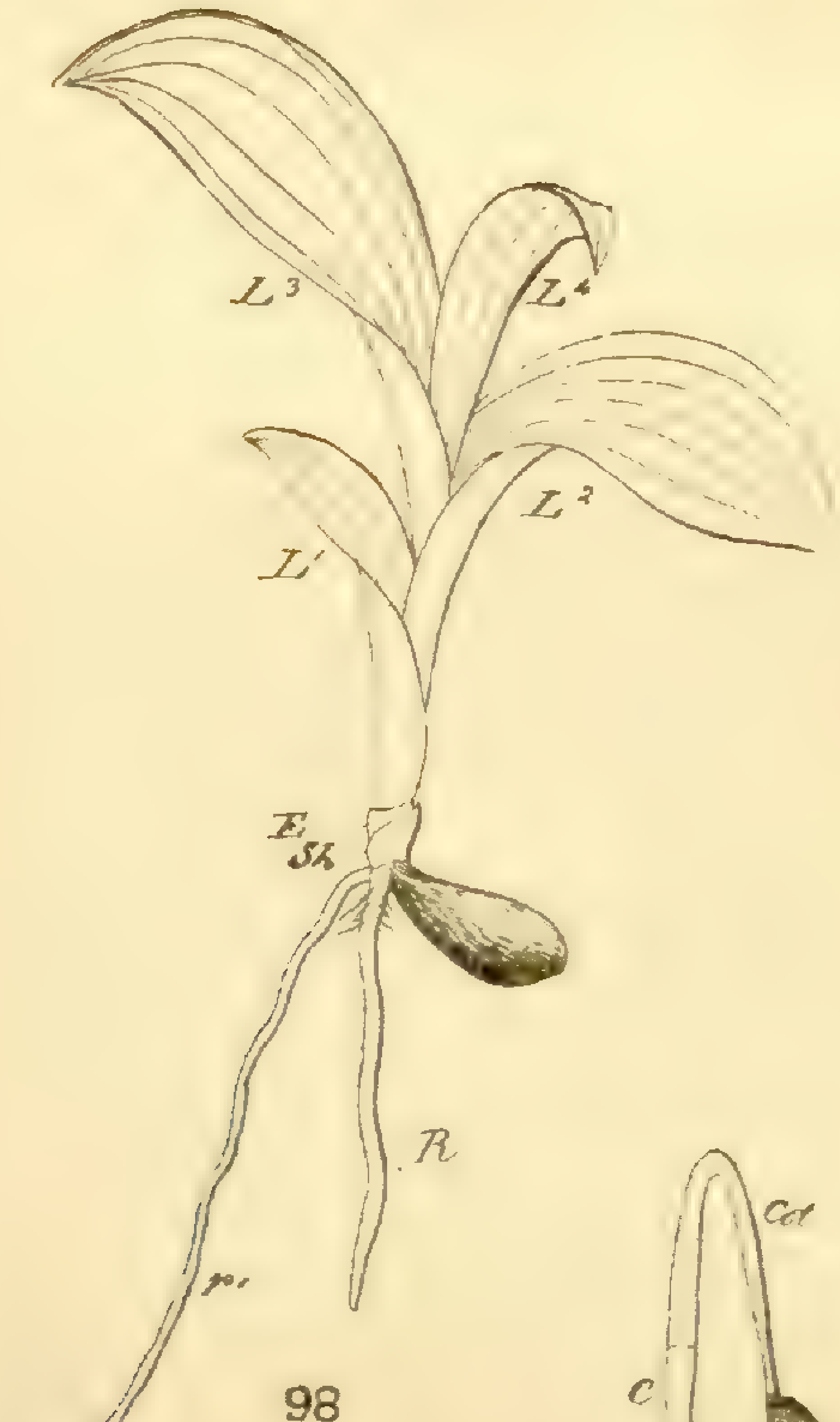


97

101



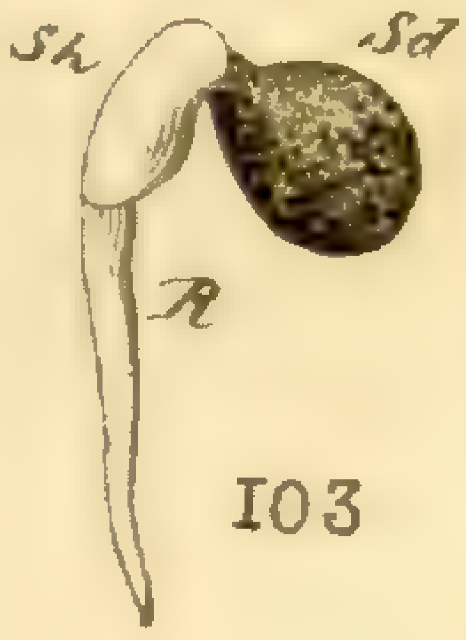
102



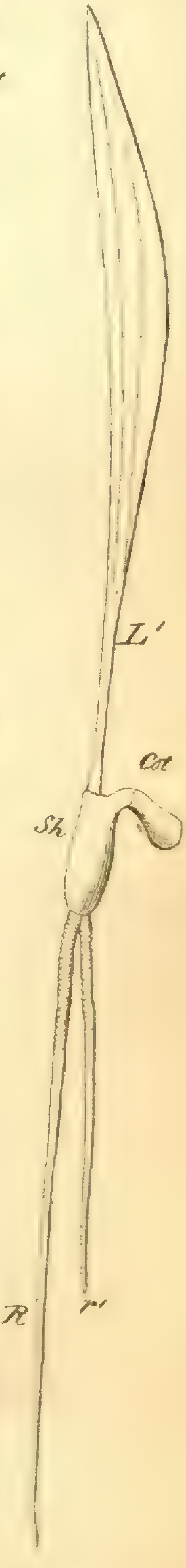
98

99

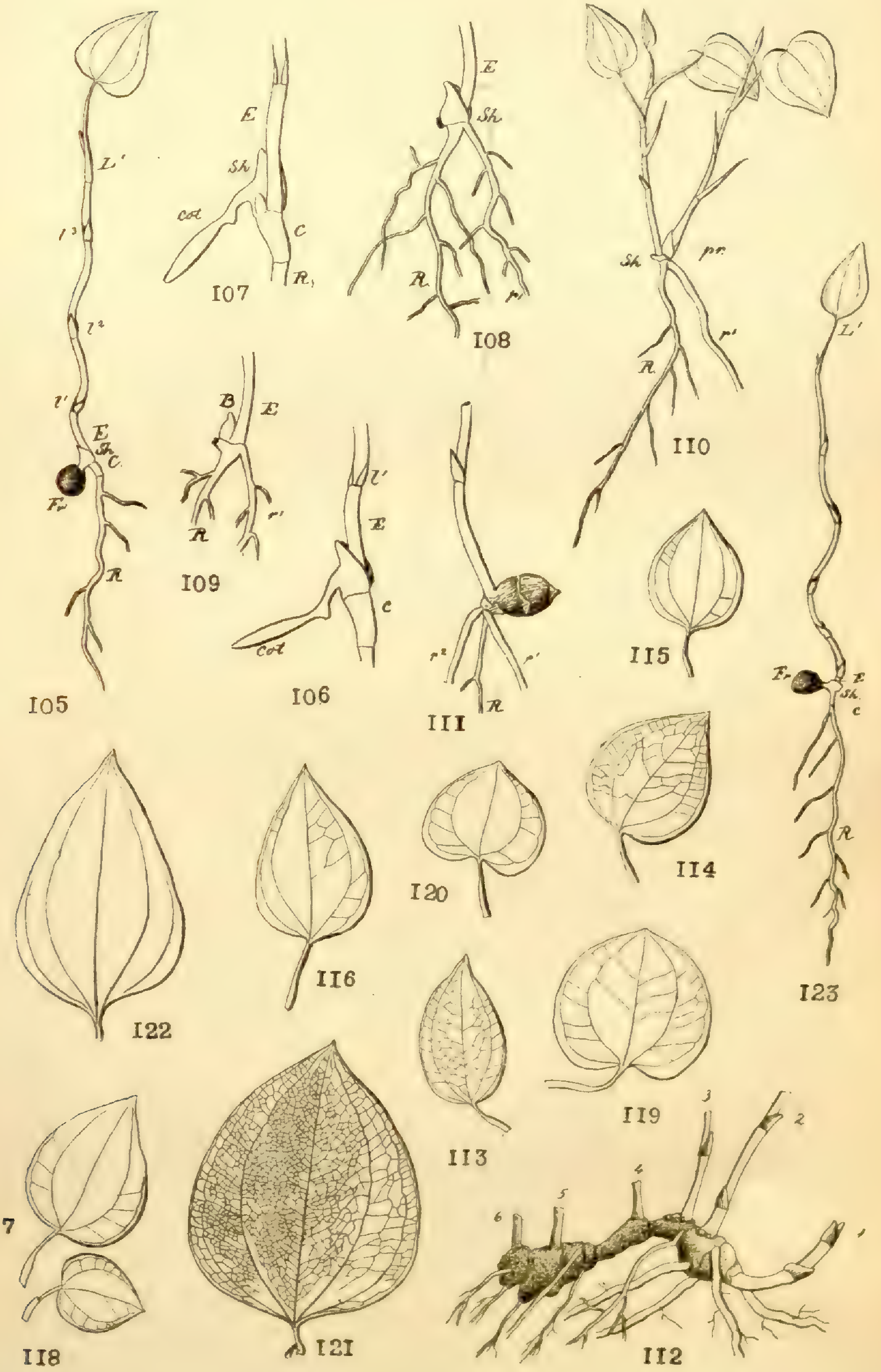
100

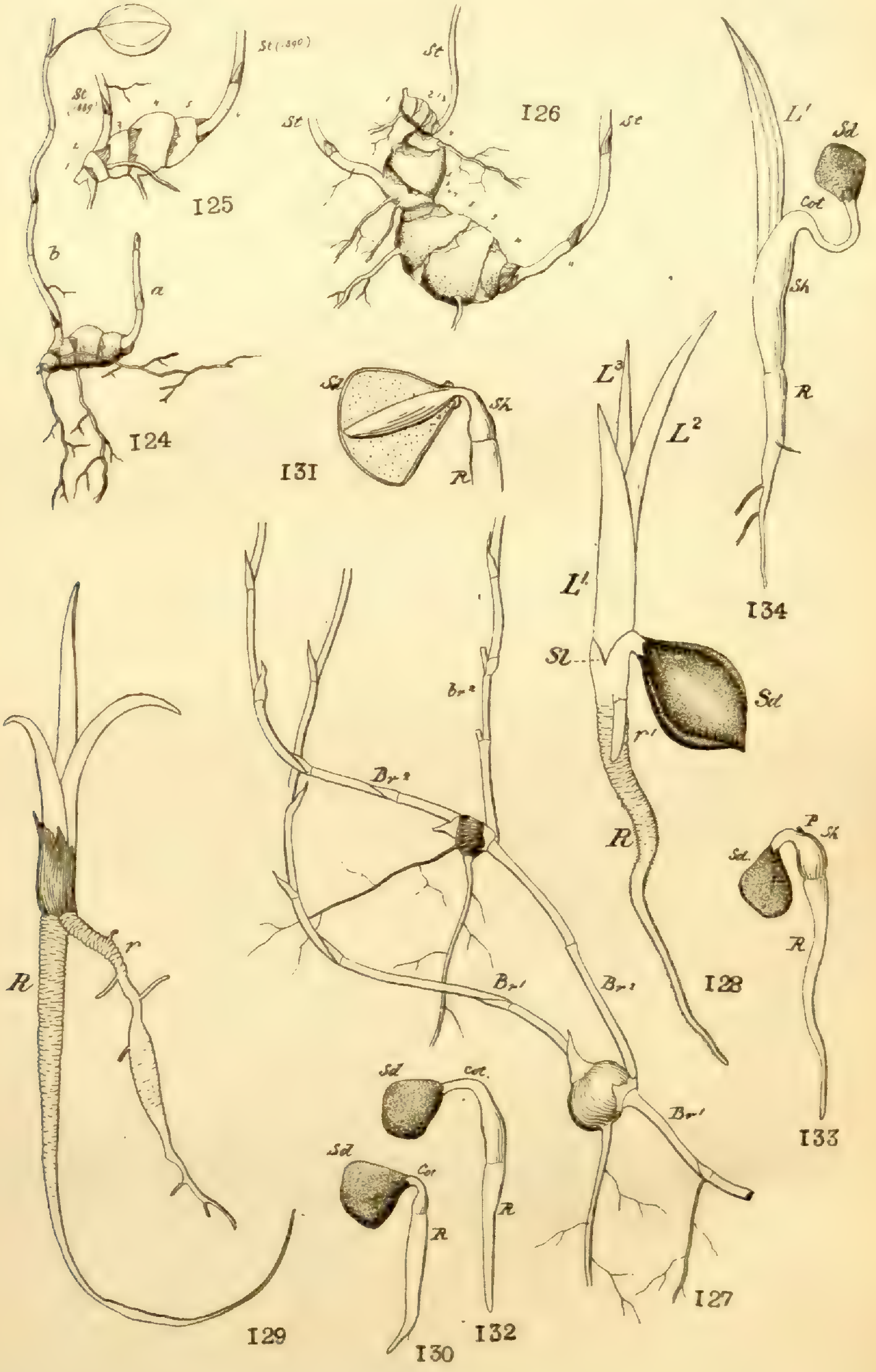


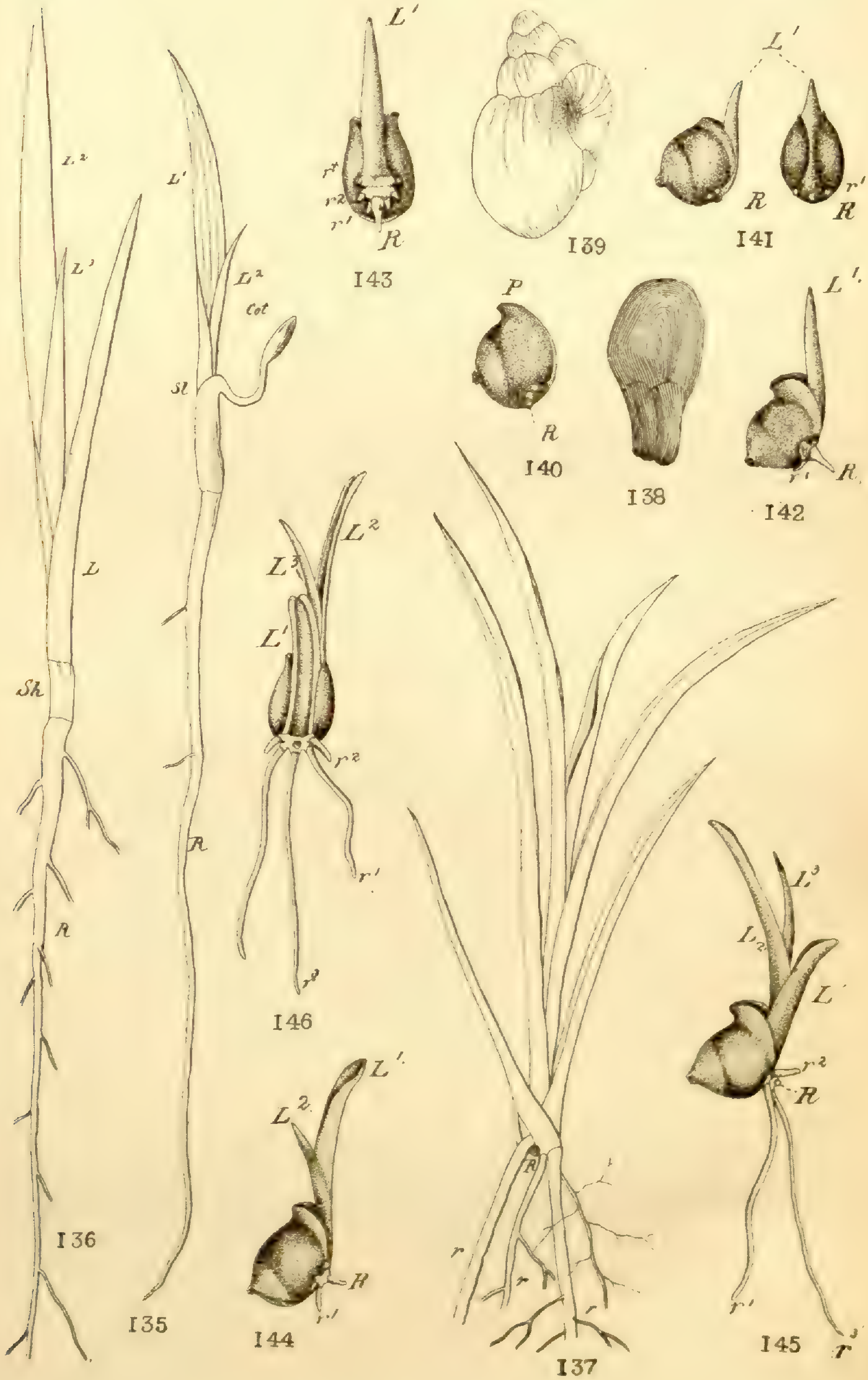
103

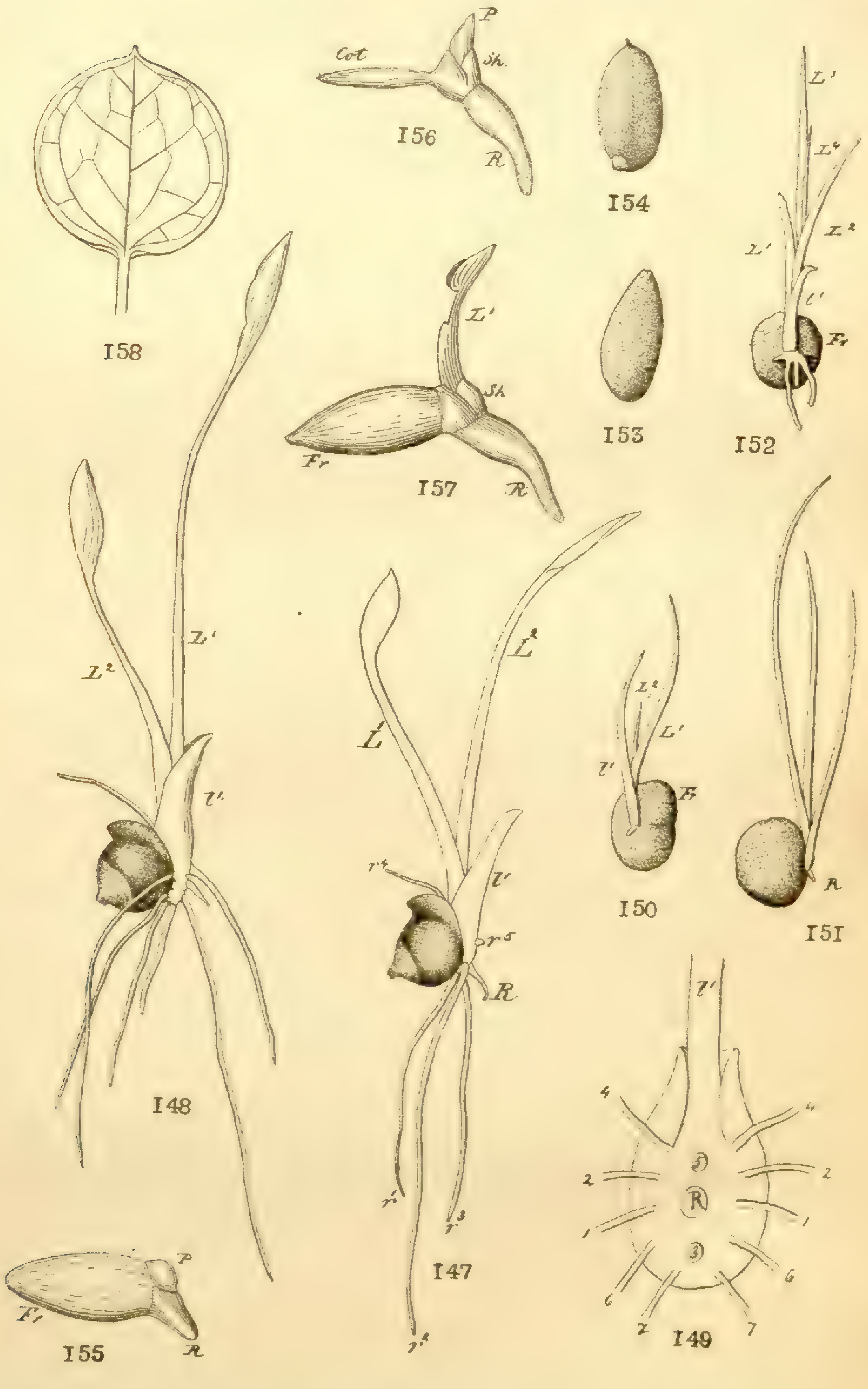


104


105
106
107
108
109
110
111
112
113
114
115
116
117
118
119
120
121
122
123


124
125
126
127
128
129
130
131
132
133
134
St
Sd
Sh
R
L^1
L^2
L^3
Cot
Br^1
Br^2




158
156
154
153
152
157
148
147
150
151
149
155

159
160
161
162
163
164
165
166
167

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

VOL. II. NO. 4.

The Genus Polygala in North America.

BY WM. E. WHEELOCK.

ISSUED DECEMBER 30, 1891.

PRICE, 75 CENTS.

MEMOIRS

OF THE

TORREY BOTANICAL CLUB.

Vol. II. No. 4

THE GENUS POLYGALA IN NORTH AMERICA.

By Wm. E. Wheelock

There being no monograph of our species of *Polygala* published since the treatment of the genus in Torrey and Gray's Flora of North America, in 1838-1840, I undertook their study about a year ago, at the suggestion of Dr. N. L. Britton. I have endeavored to see as many specimens of the species as could be found in the largest American Herbaria, and Dr. Britton has examined most of the types preserved in Europe. The American collections which I have examined are noted at the close of this paper. I would most cordially thank the gentlemen, who own or control these collections, for their kindness in allowing me to examine them. All the specimens seen are geographically recorded in the following pages, with the intention of making the work a contribution to the subject of geographical distribution, as well as a monograph of the species themselves.

The genus was published by Linnæus, in Gen. Pl. Ed. 1, p. 214, and is attributed to Dioscorides by Prof. E. L. Greene, (Fl. Fran. 93).

The following key is planned to lead to a ready determination of the species.

§ 1. Keel provided with a fimbriate or papillose crest.

† Flowers in spikes arranged in a corymb at the summit of the stem.

‡ Root-leaves long, narrow, acuminate. 1. P. cymosa.

‡‡ Root-leaves spatulate or obovate.

* Spikes loose, flowers yellow. 2. P. ramosa.

** Spikes compact, flowers white. 3. P. Baldwinii.

†† Flowers in solitary spikes terminating the stem and branches.

‡ Root-leaves spatulate or obovate.

* 1°-2° high. 4. P. Rugelii.—Florida.

** 6′-1° high. 5. P. lutea.—L. I. to Miss.

*** 1′-6′ high. 6. P. nana.—S. C. to L.

‡‡ Root-leaves inconspicuous or absent.

* Leaves verticillate, at least those below the middle of the stem. (except in P. Boykinii, var. sparsifolia).

Spikes ovoid, compact.

o Spikes sessile or nearly so; wings deltoid-acuminate or deltoid-ovate. 7. P. cruciata.

oo Spikes peduncled; wings lanceolate-ovate. 8. P. brevifolia.

Spikes ovoid-apiculate, loose. 9. P. Hookeri.

Spikes conical.

o Spikes 2″-3″ in diameter at base, lower leaves obovate, elliptical, lanceolate or linear-lanceolate. 10. P. Boykinii.

oo Spikes 1″-2″ in diameter at base, all the leaves subulate-linear or acicular. 11. P. leptostachys.

** Leaves verticillate and alternate.

Verticillate leaves predominating; spikes dense. 12. P. verticillata.

Alternate leaves predominating; spikes slender, loose. 13. P. ambigua.

*** Leaves all alternate.

Petals united into a conspicuous, slender, cleft tube 3″-4″ long. 14. P. incarnata.

Petals not united into a conspicuous tube.

o Leaves reduced to scales. 15. P. setacea.

oo Leaves never reduced to scales.

□ Spikes slender, 1″-2″ in diameter, often becoming much elongated and loose, leaves acicular, bracts deciduous. 16. P. leptocaulis.

□□ Spikes ovoid to globose.

△ Leaves linear to linear-oblong.

‖ Bracts persistent.

+ Spikes blunt, wings broadly ovate, imbricated. 17. P. viridescens.

+ + Spikes more or less apiculate, wings narrowly ovate or elliptical. 18. P. Curtissii.

|| || Bracts deciduous. 19. P. Mariana.

△ △ Leaves acicular, bracts persistent. 20. P. Chapmanii.

□ □ □ Spikes cylindrical.

△ Leaves small, 2″-6″ long, oblanceolate to linear. 21. P. Nuttallii.

△ △ Leaves lanceolate. 22. P. Senega.

□ □ □ □ Spikes conical. 23. P. alba.

††† Flowers in racemes.

‡ Leaves subulate-linear.

* Mature capsule obscurely half-winged, or wingless. 24. P. scoparia.

** Mature capsule distinctly half-winged. 25. P. hemipterocarpa.

‡‡ Leaves oblanceolate to oblong. 26. P. polygama.

†††† Flowers large, 1-4, axillary, but apparently terminating the stem. 27. P. paucifolia.

§ 2. Keel with no proper crest, but furnished with a solitary, beak-like process.

† Flowers 2″-3″ long.

‡ Beak slender, almost filiform, about ½″ long.

* Leaves oval to lanceolate. 28. P. Lindheimeri.

** Leaves linear-lanceolate to linear. 29. P. Tweedyi.

‡‡ Beak short, conical, blunt, or represented by a mere ridge; branches spinose. 30. P. acanthoclada.

†† Flowers 4″-6″ long.

‡ Beak blunt.

* Branches often spinose. 31. P. subspinosa.

** Branches spineless.

Leaves canescent. 32. P. Rusbyi.

Leaves glabrous or puberulent. 33. P. Californica.

‡‡ Beak acicular. 34. P. cornuta.

§ 3. Keel without crest or beak.

† Flowers solitary, scattered. 35. P. macradenia.

†† Flowers in racemes.

‡ Leaves broadly ovate to ovate-lanceolate. 36. P. ovatifolia.

‡‡ Leaves linear-lanceolate to lanceolate.

* Wings obovate; style curved. 37. P. puberula.

** Wings circular-deltoid; style bent at an acute angle. 38. P. grandiflora.

1. P. CYMOSA, Walter, Fl. Car. 179, (1788).

P. corymbosa, Michx. Fl. Bor. Am. ii. 54, in part, (1803.)

P. graminifolia, Poir., in Lam. Encycl. v. 500, (1804).

P. attenuata, Nutt. Genera, ii. 90, (1818).

P. acutifolia, Torr. and Gray, Fl. N. A. i. 128, (1838).

Glabrous throughout; stem erect, 2°-4° high, simple below, corymbosely branched at the summit; root-leaves rosulate, long, narrow, acuminate, 2′-6′ long, 1″-4″ broad, stem-leaves alternate, few, scattered, narrowly linear, smaller and subulate toward the summit; corymbs simple or compound; spikes ovoid or cylindrical, 3″-6″ in diameter, bracts persistent; pedicels about 1″ long; flowers yellow, becoming blackish-green when dried, wings elliptical or narrowly obovate, mucronate, nearly 2″ long, crest of keel consisting of a few small processes; stamens eight in number; style somewhat broadened at the middle and prolonged above into a curved, tufted appendage, stigmatic gland short-pedicelled; capsule minute; mature seeds brown, minute, globose, glabrous, without caruncle.

Delaware.—Ellendale, 1874, Canby. *South Carolina.*—Elliott; Santee Canal, Ravenel. *Georgia.*—Nuttall, Baldwin. *Florida.*—Chapman, Dr. Leavenworth, Mary C. Reynolds; near Jacksonville, A. H. Curtiss, No. 511; near Mayport and Jacksonville, 1870-1876, Henry D. Keeler; near St. Marks, 1843, Rugel; Polk Co., 1880, J. D. Smith; Indian River, 1874, Palmer, No. 23; Apalachicola, 1867, Dr. B. F. Saurman; Tampa, 1876, Dr. A. P. Garber. *Mississippi.*—Ocean Springs, 1889, S. M. Tracy; near Mississippi City, Harrison Co., 1885, J. D. Smith. *Louisiana.*—New Orleans, Drummond.

Type in Herb. Walter, British Museum Natural History, labelled "Polygala." N. L. B.

2. P. RAMOSA, Elliott, Fl. S. C. and Ga. ii. 186, (1824), ex descr.

P. cymosa, Poir. in Lam. Encycl. v. 500, (1804), not Walter.

P. corymbosa, Nutt. Genera, ii. 89, (1818), not Michx.

Glabrous throughout; stem erect, 6′-18′ high, simple or branching, leafy, corymbosely branched at the summit; root-leaves rosulate, spatulate or obovate, ½′-1′ long, stem-leaves alternate, scattered, narrowly spatulate, oblanceolate and lanceolate from below upwards, small; corymbs compound; spikes ovoid, less than 6″ in diameter; pedicels about 1″ long; flowers yellow, becoming blackish when dried; wings ovate-lanceolate, acuminate, about 1½″ long; crest of keel small, fimbriate; stamens eight in number; style small, slender, slightly broadened and auriculate on either side of the minute, almost sessile stigmatic gland and prolonged above into a short, tufted, in some cases two-lobed appendage; capsule minute; seeds dark brown, minute, ovoid, minutely hairy, the two caruncle-lobes scale-like, covering the extremity of the seed only.

Delaware.—Nuttall; Felton, 1867 and 1874, Canby; Ellendale, 1875, Herb. Canby. *N. Carolina.*—Rowan Co., 1890, A. A. Heller; Wilmington, Curtis. *S. Carolina.*—Ravenel, Elliott; Bluffton, Beaufort District, 1873, 1886 and 1887, Dr. Mellichamp; Sumter Co., 1884, J. D. Smith; Columbia, Dr. Gibbs; Florence, 1878, Herb. Canby; near Charleston, Dr. Bachman; Santee Canal, Ravenel. *Georgia.*—Le Conte, Dr. Harden. *Florida.*—Herb. Chapman, Mary C. Reynolds, LeConte; Miami, 1877, Dr. Garber; Tampa, 1876, Dr. Garber; near Jacksonville, A. H. Curtiss, No. 522; near Mayport and Jacksonville, 1870-1876, Henry D. Keeler; Indian River, 1874, Palmer, No. 24; Apalachicola, 1867, Dr. Saurman. *Mississippi.*—Ocean Springs, 1890, Miss Skeehan. *Louisiana.*—Hale, Carpenter, Tainturier; Covington, T. Drummond, No. 99; New Orleans, 1832, T. Drummond, No. 37. *Texas.*—Dr. Leavenworth.

3. P. Baldwinii, Nutt. Genera, ii. 90, (1818).

Glabrous throughout; stem erect, 1-2 high, simple, or branching above, corymbosely branched at the summit; root-leaves spatulate or obovate, ½′-1′ long, stem-leaves alternate, scattered, the lower ones narrowly spatulate, ¾′ long,

the upper lanceolate and shorter; corymbs simple or compound; spikes ovoid or globose, compact, 3″-6″ in diameter; flowers white, almost sessile, wings nearly 2″ long, ovate-lanceolate, contracted above into a long narrow point, crest of keel minute, fimbriate; stamens eight in number; style much as in the preceding species; capsule minute; seeds dark brown, minute, ovoid, hairy, the two caruncle-lobes very minute, scale-like.

Georgia.—LeConte. *Florida.*—Dr. Baldwin, (type), Herb. Chapman, Mary C. Reynolds, Buckley, Herb. Canby; near Jacksonville, A. H. Curtiss, No. 504; near Mayport and Jacksonville, 1870-1876, Henry D. Keeler; Apalachicola, 1867, Dr. Saurman; Hibernia, 1869, Canby; Rosewood, 1876, Dr. Garber; Tampa, 1876, Dr. Garber; near St. Marks, 1843, Rugel; Indian River, 1874, Palmer, No. 25; Pine Key.

Type in Herb. Acad. Nat. Sci. Phila.

Var. CHLORGENA, T. and G. Fl. N. A. i. 129, (1838).

Flowers becoming green when dried.

Florida.—Everglades, Miami, 1877, Dr. Garber.

4. P. RUGELII, Shuttleworth, in Chapm. Fl. S. U. S. Suppl. 613, (1882).

P. Reynoldsiæ, Chapm. loc. cit. (1882).

Glabrous throughout; stem erect or ascending, 1°-2° high, simple or branching, somewhat angled above; root-leaves and lower stem-leaves 1′-2′ long, spatulate, the rest smaller, lanceolate and acute, alternate; spikes long-peduncled, ovoid or globose, 6″-9″ in diameter, compact; flowers yellow, becoming dark blue when dried, wings obovate or obovate-elliptical, about 3½″ long, cuspidate, more or less distinctly 7-9 veined, crest of keel consisting of a few short, thick processes, some of which are more or less bifid; stamens eight in number; style rather long and slender, auriculate above the middle on either side of the long pedicelled somewhat pendulous stigmatic gland, and prolonged above into a tufted appendage; capsule small, seeds small, obovoid,

slightly curved, hairy, brownish, the two caruncle-lobes broad, spongy, almost as long as the seed itself.

The validity of *P. Reynoldsiæ*, Chapman, is doubted by the collector. The plant seems to me to be a stout form of the above.

Type of *P. Rugelii* in Herb. Kew. Authentic specimen of *P. Reynoldsiæ* in Herb. Col. Coll.

Florida.—Buckley, Dr. B. Smith, Palmer; Manatee, 1845, Rugel, No. 26; Manatee Co., 1887, Dr. Rothrock; Tampa Bay, 1839, Dr. Leavenworth; Tampa, 1877 and 1878, Dr. Garber, No. 11; Lake Monroe, 1876, Dr. Garber; Polk Co., 1880, J. D. Smith; Mosquito Lagoon, A. H. Curtiss, No. 522;* near St. Augustine, 1882, Miss Mary C. Reynolds, (dist. as *P. Reynoldsiæ*, Chapman); near St. Augustine, Miss Flint, (dist. as *P. Reynoldsiæ*, Chapman).

5. P. LUTEA, L. Spec. Pl. 705, (1753).

P. pseudo-senega, Bertol. Bot. Misc. xv. 21, t. 3, f. 2. (1854)., fide Gray in Am. Jour. Sci. ii. 24, 287.

Glabrous throughout; stems ascending, flexuous, 6′-12′ high, simple or branched, more or less striate; root-leaves rosulate, spatulate, ½′-2′ long, or, in some cases, few, broadly spatulate, smaller; stem-leaves alternate, oblanceolate or lanceolate, ½′-1½′ long, the lower ones obtuse, the upper acute; spikes ovoid or globose, 6″-9″ in diameter, compact; pedicels 1″-1½″ long; flowers orange-yellow, wings obovate-elliptical, cuspidate, 2″-3″ long, about 7-veined, crest of keel small, fimbriate; stamens eight in number; style rather long and slender, minutely cucullate above the middle around and above the distinctly pedicelled stigmatic gland and prolonged above into a slender, slightly curved, tufted appendage; capsule small; seeds dark-brown, long-ovoid, small, slightly hairy, somewhat curved, minutely beaked, the two caruncle-lobes narrow, almost as long as the seed.

New York.—Long Island, Babylon, 1868, Herb. James S. Merriam. *New Jersey.*—Pine barrens, 1856, Dr. Short; Burlington, S. W. Conrad; Bordentown, 1876, Dr. Porter;

Camden Co., 1867, C. F. Parker; Atlantic Co., 1886, C. E. Smith; near Quaker Bridge, 1860, D. C. Eaton. *Pennsylvania.*—Bristol, 1866, J. C. Martindale. *Delaware.*—Wilmington, Wm. M. Canby. *Maryland.*—Salisbury, 1863, Herb. Canby; Eastern Shore of Maryland and Virginia, Canby. *South Carolina.*—Bluffton, 1873, Dr. Mellichamp. *Georgia.*—Capt. LeConte, 1840; Savannah, Mrs. Say. *Florida.*—Chapman, Dr. Edw. Palmer; near Jacksonville, A. H. Curtiss, No. 517; St. John's Co., 1879, J. D. Smith; St. John's Co., Pellicier's Creek, 1882, J. D. Smith; Hibernia, 1869, Canby; Lake Monroe, 1876, Dr. Garber; Palatka, 1876, Dr. Garber; near Mayport and Jacksonville, 1870-1876, H. D. Keeler. *Alabama.*—1846, F. M. Reese; Mobile, 1845, Sullivant. *Mississippi.*—Ocean Springs, 1890, Miss Skeenan.

Type in Herb. Linn. Good flowering specimens from Kalm. N. L. B.

6. P. NANA (Michx.), D. C. Prodr. i. 328, (1824).

P. lutea, var. *nana*, Michx. Fl. Bor. Am. ii. 54, (1803).

P. viridescens, Walter, Fl. Car. 178, (1788). Nutt. Genera, ii. 88, (1818), not L.

Glabrous throughout, low; stems, in most cases several although occasionally single, ascending, curved, 1′-6′ high, more or less striate; root-leaves rosulate, spatulate; stem-leaves wanting or few, alternate, scattered, narrowly spatulate or oblanceolate, cuspidate; spikes compact, cylindrical, ovoid or globose, 3″-6″ in diameter and ½′-1½′ long, minutely squarrose with the acuminate tips of the wings, in some cases the young spikes smaller and short-conical; flowers nearly sessile, yellow or yellowish-green, becoming black or greenish-black when dried, wings ovate-lanceolate, long-acuminate, about 2½″ long; crest of keel composed of several long, narrow, acute processes, some of them bifid; stamens usually six in number; style slender, somewhat curved, minutely cucullate near the summit around and above the sessile, or nearly sessile, stigmatic gland, and tufted above, appendage short, tuft almost sessile; capsule small; seeds

small, obovoid, dark brown, hairy, curved, conspicuously beaked, the two caruncle-lobes narrow, diverging, ⅔ the length of the seed.

South Carolina.—Nuttall, 1824, ex. Herb. J. Gay. *Georgia.*—LeConte, Boykin, Dr. Bacon. *Florida.*—1843, Rugel; 1874, Mary C. Reynolds; Chapman, No. 18; Polk Co., Fort Meade, 1880, J. D. Smith; St. John's Co., 1879, J. D. Smith; Manatee, 1878, Dr. Garber; Miami, 1877, Dr. Garber; Hibernia, 1869, Canby; Indian River, 1874, Dr. Edw. Palmer, No. 27; Duval Co., 1882, J. D. Smith; St. John's River, 1872, Dr. Torrey; near Jacksonville, A. H. Curtiss, No. 518; near Mayport and Jacksonville, 1870-1876, Henry D. Keeler. *Alabama.*—Mobile, 1845, Sullivant. *Mississippi.*—1888, S. M. Tracy; 1885, A. B. Langlois. *Louisiana.*—Hale; New Orleans, Dr. Ingalls; Feliciana, Carpenter. *Arkansas.*—Dr. Leavenworth.

Type of *P. lutea*, var. *nana*, Michx. in Herb. Michaux; fide Torr. and Gray.

7. P. CRUCIATA, L. Spec. Pl. 706, (1753).
P. cuspidata, Hook. Journ. Bot. i. 194, (1834), not D. C.

Glabrous throughout; very variable in size; stem erect or ascending, 4′-16′ high, more or less distinctly 4-angled, simple or branched, stout or slender; leaves verticillate in fours, or, in some cases, in fives, variable in size and shape, ¼′-1½′ long, linear, oblanceolate, spatulate, or even narrowly elliptical, more or less distinctly resinously punctate; spikes sessile or upon very short peduncles, ovoid, or in some cases almost cylindrical, compact, 3″-9″ in diameter, usually conspicuously squarrose with the acuminate tips of the wings; bracts persistent; flowers greenish-purple, pink, or almost white; pedicels about 1″ long; wings conspicuous, deltoid-acuminate or deltoid-ovate, 1½″-2½″ long; crest of keel small, consisting of a few short and rather thick processes, stamens eight in number, style rather slender, somewhat curved, minutely cucullate above the middle, above and around the short pedicelled stigmatic gland, and terminating

above in a short, slender, curved, minutely tufted appendage; capsule small; seeds dark brown, small, obovoid, slightly curved, sparsely hairy, the two caruncle-lobes narrow, almost as long as the seed.

Maine.—Wells, 1880, Joseph Blake. *Massachusetts.*—Plymouth, Oakes; Manchester, Herb. Oakes; Plymouth, E. Tuckerman, Jr. (fls. almost white). *Connecticut.*—New Haven, Edgerton, D. C. Eaton; Stratford, Eaton. *New York.*—Staten Island, Tottenville, 1878, N. L. Britton; Long Island, River Head, 1877, E. S. Miller; East Hampton, 1890, Wm. E. Wheelock. *Pennsylvania.*—Read; near New Texas, 1861, J. J. Carter; near Bristol, 1865, C. F. Parker; Delaware Co., Tinicum, Dr. G. Smith; Lanc. Co., Smithville, 1862, T. C. Porter, 1889, J. K. Small, 1889, A. A. Heller. *New Jersey.*—Nuttall, Torrey, Gray, Jackson, 1844, ex Herb. Dr. G. Watson; Long Branch, 1852, Dr. Short; Atlantic Co., 1865, C. F. Parker; Secaucus, 1864, ex Herb. T. F. Allen; Egg Harbor, 1888, Dr. J. B. Brinton; Cape May, 1889, Dr. J. B. Brinton; Tom's River, 1867, C. F. Parker; 1870, Thos. C. Porter; Secaucus Swamp, 1864, Wm. H. Leggett. *Delaware.*—Felton, 1867, Herb. Canby. *Maryland.*—Stockton, 1889, H. H. Rusby; Maryland and Virginia, Canby. *West Virginia.*—Webster Co., Upper Glade, 1890, Dr. C. F. Millspaugh, No. 541. *Kentucky.*—Mts., 1835, Dr. Short; "knobs about Crab Orchard," Dr. Short. *North Carolina.*—Henderson Co., 1881, J. D. Smith. *South Carolina.*—Santee Canal, Ravenel; Bluffton, 1874, Dr. J. H. Mellichamp; Greenville Co., 1881, J. D. Smith. *Georgia.*—1840, Asa Gray; Tallulah Falls, 1846, Porter. *Florida.*—Chapman, Mrs. Meehan, Lt. Alden; New Smyrna, 1874, Dr. Palmer, No. 30; near Mayport and Jacksonville, 1870-1876, Henry D. Keeler; Duval Co., A. H. Curtiss, No. 509; Quincy; Apalachicola. *Alabama.*—Gates; Gadsden, 1878, G. R. Vasey. *Louisiana.*—Tainturier; Alexandria, Hale. *Minnesota.*—1848, Dr. C. C. Parry; St. Croix, 1861, ex Herb. T. J. Hale; Hennepin Co., 1889, J. H. Sandberg. "Am. Sept. (Pursh's specimen)," in Herb. Phil. Acad. Nat. Sciences.

Type of "Polygala foliis quaternis," Gronov., on which the species is based, in Herb. Mus. Brit. N. L. B.

8. P. BREVIFOLIA, Nutt. Genera, ii. 89, (1818).

P. cruciata, Torr. and Gray, Fl. N. A., i. 127, (1838), in part.

Glabrous throughout; stem erect or ascending, often slender, weak or flexuous, more or less angled, 8′-2 high, branched, or in some cases simple; leaves verticillate, except in some cases the upper ones, usually in fours, much like those of the preceding but often thinner and more conspicuously black-punctate; spikes ovoid, about ½′ in diameter, in some cases slightly apiculate, rather compact, peduncled, peduncles often long; bracts persistent; wings lanceolate-ovate, mucronate, the mid-vein thickened and prominent at the tip, or, in some cases, almost pointless, in other respects the flowers much as in the preceding species; stamens eight in number; capsule and seeds much as in the preceding species.

New Jersey.—Nuttall, (type), Dr. Torrey, A. Gray; Pine Barrens, 1820, Dr. Torrey, in company with Mr. Nuttall, (dist. as *P. fastigiata*, Nutt.); Hammonton, 1890, Dr. J. B. Brinton; Brown's Mills, 1864, Diffenbaugh; Atsion, 1867, C. F. Parker; Tom's River, 1874, C. F. Parker; Pine cottage, S. W. Conrad; "Head waters of Aucocas, 4 miles south of Hanover Furnace," S. W. Conrad, (dist. as *P. cruciata*, Pursh.); Quaker Bridge, 1866, E. Diffenbaugh; Quaker Bridge, 1861, Herb. Canby; Forked River, 1889, Dr. N. L. Britton; Secaucus, T. F. Allen. *Florida.*—Chapman. *Mississippi.*—Ocean Springs, 1889, S. M. Tracy, (dist. as *P. cruciata*, L.).

Type in Herb. Acad. Nat. Sci. Phila.

9. P. HOOKERI, Torr. and Gray, Fl. N. A., i. 671, (1840).

P. attenuata, Hook. Journ. Bot. i. 195, (1834), not Nuttall.

Glabrous throughout; stem rather slender, weak, erect, more or less distinctly 4-angled, 6′-12′ high, in most cases

much branched, occasionally simple; stem-leaves verticillate, usually in fours, the lower ones very small, 1″-2″ long, the rest 3″-6″ long, linear, acute, in some cases indistinctly resinously punctate, those upon the branches often alternate, scattered; spikes rather long-peduncled, ovoid-apiculate, loose, ¼′-½′ in diameter; bracts persistent; flowers pale rose-color, the lower ones on pedicels about 1″ long; wings almost 2″ long, ovate-lanceolate, mucronate, about 6-veined and having in each tip a small ovoid callosity with a more or less cordate base; crest of keel small, fimbriate; stamens eight in number; style much as in *P. cruciata*; capsule small; seeds small, ovoid, hardly curved, dark brown, sparsely hairy, the two caruncle-lobes as long as, or even longer than, the seed.

Florida.—Chapman; Apalachicola, Herb. Chapman; 1867, Dr. B. F. Saurman. *Alabama.*—Baldwin Co., C. Mohr. *Mississippi.*—Ocean Springs, 1889, S. M. Tracy. *Louisiana.*—New Orleans, Drummond; Jacksonville, Drummond, No. 131.

Type in Herb. Kew. N. L. B.

10. P. BOYKINII, Nutt. in Journ. Acad. Phil. vii. 86, (1834).
P. bicolor, Hook. Journ. Bot. i. 194, (1834).

Glabrous throughout; stems usually several, erect, or curved and ascending, 1°-2° high, more or less angled, or striate, often slender, simple or branched above; stem-leaves verticillate, at least those below the middle of the stem, in fours or fives, the lower obovate, about ¼′ long, the rest ½′-1′ long, elliptical, lanceolate, or linear-lanceolate, often cuspidate; upper stem-leaves, as well as those upon the branches, in many cases, alternate, narrow; spikes conical, 2″-3″ in diameter at the base, 1′-3′ in length, long-peduncled; bracts deciduous; flowers white, or greenish-white, almost sessile, wings broad-ovate, obovate, or almost circular in outline, concave, about 1″ long; crest of keel small, made up of a few rather broad processes; stamens eight in number; style short, minutely auriculate on either side of the pedicelled stigmatic

gland and terminating above in a short, curved, tufted appendage; mature capsule 1½″-2″ long; seeds obovoid, curved, very hairy, the two caruncle-lobes broad, often overlapping one another, ½-¾ the length of the seed, or, in some cases, longer.

Georgia.—1830, Boykin, (type); 1835, Dr. Short; Monticello Co., 1846. *Florida.*—Dr. Chapman, A. P. Garber; Aspalaga, Herb. Chapman; near Chattahoochee, A. H. Curtiss, No. 605, (or 506)?; near Appalachicola, ex Herb. C. Mohr; Pine Key, Mr. Blodgett; Sarasota, 1876, Dr. A. P. Garber; "Florida and Alabama," 1833, Rugel. *Alabama.*—Mr. Buckley; 1855, Hatch; Asheville, 1878, G. R. Vasey, No. 85; Tuscaloosa, 1883, C. Mohr; Perry Co., 1885, J. D. Smith; near Blount Springs, 1884, J. D. Smith; Blount Co., 1884, J. D. Smith, (the axis of inflorescence marked with the scars of fallen bracts for a distance of six inches.) *Mississippi.*—"Lake," S. M. Tracy; Brookhaven, 1882, Miss M. B. Flint. *Louisiana.*—New Orleans, 1833, Drummond, No. 36.

Type in Herb. Acad. Nat. Sci. Phila.

Var. SPARSIFOLIA, n. var.

1½°-2° high; branching irregularly, leaves small, 2″-6″ long, about 1″ broad, cuspidate, few, scattered, alternate, the lowest of all in some cases verticillate.

South Florida.—Cudjoe Key, (coral soil), A. H. Curtiss, No. 503,* (dist. as *P. ambigua*, Nutt. var.)

Type in Herb. Col. Coll.

11. P. LEPTOSTACHYS, Shuttl. in A. Gray's Pl. Wright. i. 41, (1852).

Glabrous throughout; stem usually single, erect, straight or slightly curved, slender, 1°-1½° high, simple or with one or two filiform branches near the summit; stem-leaves verticillate in fours or fives, subulate-linear or acicular, 2″-8″ long, the whorls far apart, few; spikes narrowly conical, 1″-2″ in diameter at the base, about 6″ long, or becoming longer later; bracts deciduous; flowers greenish, almost sessile, wings oval, obtuse, less than 1″ long, shorter than the mature

capsule; crest of keel minute, consisting of a few short, thick processes; stamens eight in number; style minute, cucullate or auriculate above and on either side of the pedicelled stigmatic gland, the terminal tufted appendage short, filiform; mature capsule about 1″ long; seeds dark brown, small, clavate or clavate-obovoid, curved, smooth, or slightly hairy at the broader end, papillose, the two caruncle-lobes narrow, oblanceolate, ½-¾ the length of the seed.

Florida.—Herb. Chapman; 1828, Dr. Leavenworth; near Aspalaga, 1843, Rugel, (type); near Jacksonville, A. H. Curtiss, No. 516; Duval Co., 1876, A. H. Curtiss; Gainesville, 1876, Dr. A. P. Garber; "Sand hills," Herb. Chapman, (dist. as *P. attenuata*, Hook.?). Type in Herb. Col. Coll.

12. P. VERTICILLATA, L. Spec. Pl. 706, (1753).

Glabrous throughout; stem erect, straight or flexuous, 2′-10′ high, angled, branched, very variable as to size and habit, short, stout, with spreading branches, or taller, more slender, with branches more or less fastigiate; leaves linear-lanceolate to linear, acute, ½′-1′ long, those of the stem in most cases verticillate in fours or fives, while those upon the branches, and frequently some upon the stem also, are alternate; spikes conical, 2″-3″ in diameter at the base, ¼′-1′ long; peduncles in the short, stout forms short, in the taller forms somewhat elongated; bracts deciduous; flowers greenish-white, on very short pedicels, wings broadly ovate, about ½″ long, not venose, only the mid-vein conspicuous; crest of keel small, made up of several rather short and thick processes; stamens eight in number; style very short and small, the tufted appendage minute, filiform; the mature capsule about 1″ long, apparently much longer than the wings, which at this stage are not as a rule closely appressed to it but are twisted or reflexed so as to leave the capsule more or less uncovered; seeds small, narrowly obovoid or obovoid-clavate, dark brown, hairy, or in some cases glabrous, the two caruncle-lobes narrow, collateral or diverging, about half as long as the seed.

Canada.—Manitoba, Griswold, 1887, W. A. Bunnan, (a small form only 2′-3′ high); Ontario, near Queenston Heights, 1877, Macoun, No. 377; Saskatchewan, 1858, Bourgeau; Niagara Falls, ex Herb. Macnab. *Maine.*—Mt. Desert Island, S. W. Harbor, 1887, E. L. Rand; Orono, 1889, M. L. Fernald. *New York.*—Dr. Devan; Penn Yan, Dr. Sartwell; West Point, 1887, N. L. Britton; Coney Island, 1887, N. L. Britton; Staten Island, New Dorp, 1890, N. L. Britton. *Massachusetts.*—Essex Co., Herb. Oakes. *Pennsylvania.*—Dr. Griffith; Philadelphia, 1824, "Nuttall misit;" Lancaster Co., Safe Harbor, 1864, T. C. Porter; Lehigh Co., Slatington, 1868, R. G. Bechdolt; Perry Co., Marysville, 1888, T. C. Porter; Huntingdon Co., J. R. Lowrie; vicinity of Conewago, 1889, J. K. Small; Easton, Dr. Traill Green; Bethlehem, 1832, C. J. Moser. *New Jersey.*—Rosemont, 1883, Thos. C. Porter, 1886, G. N. Best; above Phillipsburg, 1882, T. C. Porter; Bergen Co. and Hudson Co., 1890, M. Timmerman; Morris Co., Port Oram, 1886, N. L. Britton; near Ironia, N. L. Britton; near Lake Hopatcong, 1886, N. L. Britton; Sussex Co., near Andover, 1887, N. L. Britton; Sparta, N. L. Britton. *Delaware.*—Herb. Wm. M. Canby. *Maryland.*—Stockton, 1889, H. H. Rusby. *Georgia.*—Jasper Co., 1846, T. C. Porter. *Florida.*—Rosewood, 1876, Dr. A. P. Garber. *Texas.*—Chas. Wright, Drummond, No. 26; Tom Greene Co., 1879, Frank Tweedy; Hempstead, 1872, Elihu Hall, Nos. 91 and 92. *Indian Territory.*—1868, Dr. Edward Palmer. *Arkansas.*—Dr. Pitcher, ex Herb. F. L. Harvey, No. 101. *Tennessee.*—Base of Chilhowee Mts., A. H. Curtiss, No. 503 (in part). *Kentucky.*—Greenville, 1840, Dr. Short. *Illinois.*—Beardstown, 1842, Geyer. *Wisconsin.*—Lacrosse, 1861, "ex coll. T. J. Hale." *Kansas.*—Miami Co., 1884, Dr. J. H. Oyster. *Dakota.*—Black Hills, 1887, Dr. W. H. Forwood. *Wyoming.*—Yellowstone Park, 1884, Tweedy, No. 308. *Colorado.*—"North of Denver, on Clear Creek," 1870, E. L. Greene, No. 66. *Utah.*—N. of Am. Fork Cañon, Hayden's Survey, 1877; J. D. Hooker and A. Gray.

Type in Herb. Linn. Specimens from Kalm. N. L. B.

13. P. AMBIGUA, Nutt. Genera, ii. 89, (1818).

P. verticillata, L. var. *ambigua*, Wood, Bot. and Flor. 80, (1870).

Much resembling the preceding, but taller, 5′-16′ high, generally more slender and the branches more fastigiate; while the lower stem-leaves are in many cases verticillate most of the leaves of the plant are alternate; spikes, as a rule, longer than in the preceding, less compact, the flowers at the base of the spike often quite distant from each other; the peduncles often several inches in length; flowers rather larger, wings often purple, somewhat circular in outline, venose, the mid-vein and two lateral veins noticeable; mature capsule apparently less elongated, hardly longer than the wings which are more or less closely appressed to it so as to conceal it from view.

New Jersey.—Nuttall. (type). *Pennsylvania*.—1836, H. Detwiller; near Philadelphia, Herb. Phil. Acad. Nat. Sci.; Chester Co., 1889, Witmer Stone; Mercersburg, 1844 and 1850, Herb. Porter; Philadelphia, 1824, "Nuttall misit," in Herb. Gray; Columbia Co., Buckhorn, 1889, A. A. Heller; Chester Co., W. Nottingham, 1889, T. C. Porter; Chester Co., Lincoln, 1887, T. C. Porter; Chester Co., Corcoranville, 1883, Dr. J. B. Brinton; Lancaster Co., 1861, T. C. Porter, Smithville, 1865, T. C. Porter. *Delaware*.—1862, Herb. Wm. M. Canby. *Maryland*.—Garrett Co., 1879, J. D. Smith. *Virginia*.—Natural Bridge, 1885, Dr. and Mrs. N. L. Britton. *West Virginia*.—Wood Co., 1890, Dr. C. F. Millspaugh. *Kentucky*.—Mudlick, Dr. C. W. Short; Greenville, 1840, Dr. C. W. Short; "Hills about Crab Orchard," 1835, Dr. Robert Peter. *Tennessee*.—Grainger Co., 1880, J. D. Smith; base of Chilhowee Mts., A. H. Curtiss, No. 503 (in part). *Georgia*.—Herb. Chapman. *Alabama*.—La Grange, Prof. Hatch. *Louisiana*.—Hale.

Type in Herb. Acad. Nat. Sci. Phila.

14. P. INCARNATA, L. Spec. Pl. 701, (1753).

More or less glaucous; stem erect or ascending, usually

somewhat curved, 1′-2′ high, simple or sparingly branched; leaves alternate, few, scattered, ¼′-½′ long, linear-subulate, the upper ones often very small; spikes somewhat cylindrical, ½′-1½′ long, ¼′-½′ in diameter; bracts deciduous; flowers pale purple or rose color, almost sessile; wings about 2″ long, lanceolate, minutely mucronate, about five-veined, conduplicate at the tip; petals united into a conspicuous, slender, cleft tube, 3″-4″ long, two or three times as long as the wings; crest of keel conspicuous, made up of several broad and thin processes, some of which are bifid; stamens eight in number; style long, filiform, curving above, auriculate near the summit on either side of the almost sessile stigmatic gland and terminating above in a rather short, tufted appendage; mature capsule about 2″ long, cordiform-ovoid, sulcate; seeds short-ovoid, dark-brown, hairy, conspicuously beaked, the two caruncle-lobes lenticular, spongy, enveloping the beaked extremity of the seed.

New Jersey.—Dr. C. Pickering; Haddonfield, Mr. Read; Clarksboro, 1886, ex. Herb. Isaac Burk; "New Jersey to Carolina," Nuttall; "New Jersey and Illinois," W. D; Bridgeton, Britton; near Mickleton, B. Heritage. *Pennsylvania.*—Huntingdon Co., 1843; Lancaster, Porter; New Texas, 1862, J. J. Carter. *Delaware.*—Townsend, 1862, Herb. Wm. M. Canby. *Maryland.*—Salisbury, 1865, ex. Herb. Wm. M. Canby; Stockton, 1889, H. H. Rusby. *D. C.*—Georgetown, Dr. Robbins, No. 55. *Virginia.*—Norfolk, Dana; Noels', 1889, Dr. J. B. Brinton, (an almost leafless form).

North Carolina.—Rowan Co., 1890, A. A. Heller, (an almost leafless form). *South Carolina.*—Santee Canal, Ravenel; Bluffton, 1873, Dr. J. H. Mellichamp; Society Hill, 1884, J. D. Smith; Mount Pleasant, near Charlestown, Miss Fisher. *Georgia.*—Boykin; Monticello, Jasper Co., 1846, T. C. Porter; Savannah, Mrs. Say; Bull Creek, near Columbus, 1883, J. D. Smith. *Florida.*—Herb. Chapman, F. Cozzens; Indian River, 1874, E. Palmer, No. 28; Magnolia, 1883, J. D. Smith; Fort Meade, 1880, J. D. Smith; Duval Co., 1882, J. D. Smith; A. H. Curtiss, No. 515; Jacksonville, 1869, Wm. M. Canby;

near Mayport and Jacksonville, 1870-1876, Henry D. Keeler; Apalachicola, 1867, Dr. Saurman. *Alabama.*—Conecuh Co., near Evergreen, 1884, J. D. Smith. *Mississippi.*—Ocean Springs, 1890, Miss Skeehan. *Louisiana.*—New Orleans, 1832, Drummond. *Texas.*—1843, Lindheimer, No. 12, Chas. Wright; Washington Co., Miss Hobart; Hempstead, 1872, Elihu Hall, No. 93; Dallas, 1881, J. Reverchon. *Kansas.*—Miami Co., 1888, Dr. J. H. Oyster. *Arkansas.*—Dr. Leavenworth; Grand Prairie, 1883, F. L. Harvey, No. 3. *Kentucky.*—1842, Dr. C. W. Short; "Barrens," 1835, Dr. Short. *Illinois.*—1852, S. B. Mead; Augusta, 1842, S. B. Mead; Beardstown, 1842, Geyer; "Prairies," J. L. Darlington.

A form slender, almost leafless, with white flowers. *Florida.*—Rosewood, 1876, Dr. A. P. Garber.

A form stout and almost leafless. *Florida.*—St. George's Island, Herb. Chapman, (dist. as *P. incarnata*, var.); "Apa. sea-shores." Perhaps identical with "*P. paniculata*, herb. Le Conte," Torr. and Gray Flora, i. 129.

Type in Herb. Linn. Specimens from Kalm. N. L. B.

15. P. SETACEA, Michx. Fl. Bor. Am. ii. 52, (1803).

Glabrous throughout; stem single, or two or three from the same base, slender, erect, straight, or somewhat flexuous, 6'-18' high, simple, or sparingly branched; leaves represented by mere scales; spikes ovoid-conical, compact, 4''-9'' long, 2''-3'' in diameter; bracts deciduous; flowers pale-pink or whitish, almost sessile; wings about 1'' long, narrowly obovate, hardly mucronate; crest of keel small, consisting of a few short processes; stamens six in number; style short, minutely auriculate in the middle on either side of the rather long-pedicelled stigmatic gland and terminating above in a short, curved, tufted appendage; capsule small; seeds small, ovoid, hairy, the two caruncle-lobes much as in the preceding species.

Florida.—Dr. Chapman, No. 90; Dr. Leavenworth; 1875, 1877, 1878, Mary C. Reynolds; Apalachicola, Chapman; 1867, Dr. B. F. Saurman; near Jacksonville, A H Curtiss, No. 525;

near Mayport and Jacksonville, 1870-1876, Henry D. Keeler; Indian River, 1874, Dr. Edw. Palmer, No. 29; Hibernia, 1869, Wm. M. Canby; Manitee, 1876, Dr. A. P. Garber; Tampa, 1876, Dr. A. P. Garber; 1880, J. D. Smith. "*Georgia and Florida*".—Le Conte. "Am. Sept".—Dr. Baldwin.

Type in Herb. Michaux, fide Torr. and Gray.

16. P. LEPTOCAULIS, Torr. and Gray, Fl. N. A. i. 130, (1838).

Glabrous throughout; stem very slender, in some cases almost filiform, erect or ascending, often curved or flexuous, 1°-2° high, in most cases sparingly branched above, branches fastigiate; leaves alternate, acicular, few, scattered, ¼'-1' long; spikes slender, 1″-2″ in diameter, often becoming much elongated and loose; bracts deciduous; flowers pale-purple, on very short, slender pedicels, in some cases secund; wings elliptical-obovate, narrowed at the base into a short claw, ½″-1″ long, about three-veined; crest of keel small; stamens eight in number; style minute, cucullate above the middle, the stigmatic gland almost sessile, the tufted appendage minute, filiform, in some cases the tuft sessile or the entire appendage wanting; mature capsule small, less than 1″ long; seeds minute, ovoid, not curved, very hairy, the two caruncle-lobes minute, hardly to be seen.

Louisiana.—Carpenter, in Herb. Chapman; (Chateiguer), 1885, A.B. Langlois; Abbeville, 1884, A. B. Langlois. *Texas.*—Buckley, 1872, Elihu Hall, Drummond, No. 28, (type); 1843, Lindheimer, No. 11; Mr. Chas. Wright; Hemstead, 1872, Elihu Hall, No. 95; Beaumont, 1884, G. C. Nealley.

Type in Herb. Col. Coll.

17. P. VIRIDESCENS, L. Spec. Pl. 705, (1753).
P. sanguinea, L. Spec. Pl. 705, (1753).
P. purpurea, Nutt. Genera, ii. 88, (1818).

Glabrous throughout; stem more or less angled, 6'-16' high, stout, erect, branched, leafy to the top, or slender and simple;

leaves alternate, linear to linear-oblong, ½′-1′ long, acute, or almost cuspidate; spikes ovoid or globose, blunt, compact, ½′-1′ long, 4″ or 5″ in diameter, short-peduncled; bracts persistent, but in many cases only moderately so; flowers red-purple, or in forma albiflora white, sessile, or nearly so; wings imbricated, broadly ovate, 1½″-3″ long, about nine-veined, the mid-vein conspicuously thickened throughout the upper half of the wing, and usually prolonged into a mucronation; crest of keel very small, consisting of a few short, broad, thickish, in some cases retuse, processes; stamens eight in number; style somewhat broadened, and minutely auriculate at the middle, above and on either side of the almost sessile stigmatic gland, and terminating above in a rather stout, curved, tufted appendage; capsule small; seeds small, pear-shaped, dark-brown, hairy, the two caruncle-lobes collateral, diverging, or even straddling the seed, half as long as, or, in some cases, as long as the seed.

Canada.—Ontario, Point Pelee, 1881, Brodie; Windsor, 1884, J. M. Macoun. *Maine.*—Mt. Desert Island, near Seal Harbor, 1889, J. H. Redfield; Cape Elizabeth, 1889, M. L. Fernald.

New York.—Long Island, Hicksville, 1890, Geo. D. Hulst; Forbell's Landing, 1890, M. Timmerman. Staten Island, 1890, Oakwood, New Dorp, Court House, N. L. Britton.

Massachusetts.—Fair Haven, 1865, Dr. J. W. Robbins; Northampton, 1874, S. Watson; Cape Ann, 1883, Dr. J. B. Brinton; Salem, C. Pickering.

Rhode Island.—Providence, Olney; Little Compton, 1821, Miss Stretter.

New Jersey.—S. W. Conrad; Camden, 1876, I. C. Martindale; Gloucester Co., 1865, C. F. Parker; "Pine barrens," 1856, Dr. Short; Demarest, 1880, Herb. Joseph Schrenk. *Pennsylvania.*—1836, H. Dettwiller; Bethlehem, J. Wolle; Westchester, 1827, W. D.; Lancaster Co., Reinholdsville, 1866, Thos. C. Porter; Lanc. Co., Mastic Forge, 1861, T. C. Porter; New Texas, 1860, T. C. Porter; Mercersburg, 1850, Thos. C. Porter; Lebanon Co., Penryn, 1889, A. A. Heller; Harmons-

burg, 1869, Garber; Presque Isle, 1869, Garber; Northampton Co., 1861, Dr. T. Green; vicinity of Penryn, 1889, J. K. Small.

Delaware.—Herb. Wm. M. Canby; Wilmington, 1844, J. B. Brakely. *Maryland.*—Salisbury, Wm. M. Canby; Oakland, Garrett Co., 1880, J. D. Smith. *West Virginia.*—Wood Co., 1890, Dr. C. F. Millspaugh, No. 247.

Kentucky.—"Hills about Crab Orchard," 1835, Dr. Robert Peter; "Knobs of Crab Orchard," 1842, Dr. Short.

Ohio.—Darby Plains. *Illinois.*—Mt. Carmell, 1875, Dr. J. Schenck; Beardstown, 1842, Geyer; Fountaindale, Winnebago Co., Herb. M. S. Bebb; Augusta, 1842, S. B. Mead; Oquawka, 1874, Harry N. Patterson; "Prairies," J. L. Darlington. *Wisconsin.*—Juneau Co., Camp Douglas, 1890, E. A. Mearns, No. 250. *Minnesota.*—Hennepin Co., 1889, J. H. Sandberg. *Arkansas.*—Dr. Pitcher; Grand Prairie, 1883, F. L. Harvey, No. 11; ("N. W.") 1880, ex. Herb. F. L. Harvey, No. 68. *Kansas.*—1887, Dr. J. H. Oyster; Miami Co., 1885, Dr. J. H. Oyster. *Indian Territory.*—1868, Dr. Edw. Palmer, No. 74.

Type of both *P. viridescens* and *P. sanguinea* in Herb. Linn. N. L. B.

Forma ALBIFLORA. Flowers white. *Massachusetts.*—1860, Concord, Mr. Pratt. *Delaware.*—Townsend, 1872, ex Herb. Wm. M. Canby. *West Virginia.*—Webster Co., 1890, Dr. C. F. Millspaugh, No. 554.

Type in Herb. Col. Coll.

18. P. CURTISSII, A. Gray, Manual, 5th ed. 121, (1867).

Glabrous throughout; stem much as in the preceding but rather more slender; leaves alternate, linear, the upper ones acute; spikes ovoid or globose, more or less apiculate, not compact, 4″-6″ in diameter; peduncles longer than in the preceding; bracts persistent; flowers rose-purple, pedicels about 1″ long; wings narrowly ovate, or elliptical, minutely mucronate, about seven-veined, the mid-vein less prominent than in the preceding and thickened only at the tip; crest of keel small, made up of a few short, blunt, thickish processes,

some of which are often bifid; stamens eight in number; style much as in the preceding; capsule small; seeds small, dark-brown, densely hairy, pear-shaped or top-shaped, beaked at the smaller, and apiculate at the larger extremity, the two caruncle-lobes minute, obovate, scale-like, about ¼ the length of the seed.

This species was founded upon an abnormal form in which the pedicels are much elongated, making the inflorescence conspicuously racemose.

Before this fact was recognized specimens which would now be regarded as typical were referred to var. *pycnostachya*, Gray.

Pennsylvania.—Bethlehem, 1840, Mr. Wolle, (dist. as *P. Nuttallii.*)

Maryland.—Bladensburg, 1878, Lester F. Ward; Piney Point, 1874, George Vasey, (dist. as var. *pycnostachya*); Cecil Co., near Elkton, 1884, J. J. Carter, F. W. Price.

D. C.—Washington, 1886, H. W. Henshaw; 1874, Dr. Vasey; near Washington, 1878, 1879, Lester F. Ward. *Virginia.*—near Alexandria, 1865, Curtiss, (type); Alexandria Co., 1884, Lester F. Ward; Noels, 1890, Dr. J. B. Brinton; Richmond, 1887, Herb. Isaac Burk, (dist. as var. *pycnostachya*).

North Carolina.—1880, Thomas Meehan, T. C. Porter and others, (dist. as var. *pycnostachya*); "Mts." 1878, G. R. Vasey, (dist. as var. *pycnostachya*); "Western," 1880, Thos. C. Porter, (dist. as var. *pycnostachya*); Marion Co., (Hyams ?); Jackson Co., Wild Cat Ridge, 1882, J. D. Smith, (dist. as var. *pycnostachya*); Macon Co., Horse Cove, 1882, J. D. Smith, (dist. as var. *pycnostachya*); Transylvania Co., Buck Forest, 1881, J. D. Smith, (dist. as var. *pycnostachya*); Henderson Co., 1876, ex. Herb. Wm. M. Canby; Anson Co., 1884, J. D. Smith; Rowan Co., 1890, A. A. Heller; Black Mt. Station, 1885, Dr. and Mrs. N. L. Britton; Blue Ridge, 1841, Gray and Carey.

South Carolina.—Cæsar's Head, 1876, Herb. Wm. M. Canby, 1881, J. D. Smith, (dist. as var. *pycnostachya*); "Mts. of Carolina and Georgia," 1867, A. Gray.

Georgia.—Boykin; 1875, C. Wright; 1888, Geraldus Mc-

Carthy; 1846, ex. Herb. T. C. Porter. *Alabama.*—Blount Co., 1884, J. D. Smith. *Tennessee.*—1880, A. Gattinger; Chilhowee Mt., A. H. Curtiss, No. 523, (dist. as *P. sanguinea*, L.); Grainger Co., Clinch Mt., 1880, J. D. Smith, (dist. as var. *pycnostachya*). *Kentucky.*—1840, Dr. C. W. Short, (dist. as *P. purpurea*); Licking River Hills, Short; Mudlick, C. W. Short, (dist. as *P. purpurea*); Road to Red River, Dr. Short.

Type in Herb. Gray.

19. P. MARIANA, Mill. Gard. Dict. No. 6, (1768).
P. fastigiata, Nutt. Genera, ii. 89, (1818).
P. sanguinea, Torr. and Gray, Fl. i. 126, (1838), excl. syn.

Glabrous throughout; erect, or ascending and flexuous, slender, or in some cases moderately stout, 6′-18′ high, simple, or branched above; the branches often conspicuously overtopping the stem, in some cases fastigiate; leaves alternate, linear, 2″-8″ long, acute or almost cuspidate, often rather erect, the upper ones upon the branches in many cases very small, subulate and appressed; spikes ovoid or glabose, 3″-5″ in diameter; bracts deciduous; flowers rose-color, pedicels sometimes as long as 1½″; wings ovate or elliptical, almost 2″ long, about five-veined, mid-vein thickened and conspicuous at the tip; crest of keel consisting of a few short, blunt processes which are often bifid; stamens eight in number; style rather long and slender, minutely auriculate above the middle, above and on either side of the almost sessile stigmatic gland, the tufted appendage curved; capsule small; seeds small, pear-shaped with rather a long neck, slightly curved, minutely apiculate at the larger extremity, dark-brown, hairy, the two caruncle-lobes short and broad, embracing the smaller extremity of the seed.

Delaware.—Townsend, 1861, Herb. Canby; Felton, 1867, Herb. Wm. M. Canby, 1874, Wm. M. Canby; Sussex Co., Ellendale, 1875, Herb. Wm. M. Canby.

Maryland.—Near Bladensburg, 1884, Lester F. Ward; Stockton, 1889, H. H. Rusby. *D. C.*—Near Washington, 1876, J. W. Chickering, Jr.

Virginia.—Portsmouth, Rugel.

North Carolina.—Herb. Phil. Acad. Nat. Sciences; Rowan Co., 1890, A. A. Heller. *South Carolina.*—Santee Canal, H. W. Ravenel; Florence, 1878, Herb. Wm. M. Canby; near Society Hill, 1884, J. D. Smith. *Georgia.*—Taylor Co., 1876, H. N. Neisler. *Florida.*—Chapman; Hibernia, 1869, Wm. M. Canby; Picolata, 1858, Wm. M. Canby; St. Augustine, 1876, Dr. A. P. Garber; Apalachicola, 1867, Dr. Saurman. *Alabama.*—Selma, Dr. Cahill. *Louisiana.*—Hale; New Orleans, 1832, "comm. Drummond;" (West), Chateigner, 1885, A. B. Langlois; (West), Atakopus, in prairies, 1885, A. B. Langlois; (East), in pine barrens, 1885, A. B. Langlois; (East), St. Tammany Co., 1885, A. B. Langlois, No. 13. *Texas.*—Mr. Charles Wright.

Type in Herb. Mus. Brit. N. L. B.

20. P. CHAPMANII, Torr. and Gray, Fl. N. A.i. 131, (1838).

Glabrous throughout; stem erect, slender, 1′-18′ high, simple, or at length sparingly fastigiately branched; leaves alternate, acicular, 2″-9″ long; spikes long–ovoid, apiculate, 3″-4″ in diameter, or the younger ones short, almost conical; bracts persistent; flowers bright rose-color, or purplish, on pedicels almost 1″ long; wings ovate or elliptical, minutely mucronate, nearly 1½″ long, about nine-veined, the mid-vein thickened at the extreme tip; crest of keel consisting of a few, in some cases only two, minute papilloid processes; stamens eight in number; style small, minutely auriculate near the middle, above and on either side of the almost sessile stigmatic gland, the tufted appendage curved; capsule small, short; seeds small, short, pear-shaped, almost black, minutely beaked, furnished with an abundance of pale, curved hairs; the two caruncle-lobes small, short and broad, 1-5–¼ the length of the seed, and straddling its beak.

Florida.—Chapman; Walton Co., A. H. Curtiss, No. 508; West Florida, Herb. Torrey.

Alabama.—Mobile Co., 1885, Dr. C. Mohr; Mobile, 1878,

Dr. C. Mohr. *Mississippi.*—Ocean Springs, 1890, Miss Cath. Skeehan.

Type in Herb. Col. Coll.

21. P. NUTTALLII, Torr. and Gray, Fl. N. A. i. 670, (1840), excl. syn.

P. sanguinea, Nutt. Genera, ii. 88, (1818), not L.

P. ambigua, Torr. and Gray, Fl. N. A. i. 130, (1838), not Nutt.

Glabrous throughout; stem erect, slender, 4′-9′ high, branched, or in some cases simple; leaves alternate, 2″- 6″ long, those on the stem often oblanceolate, the rest linear; spikes more or less cylindrical, often apiculate, 2″-3″ in diameter; bracts persistent; flowers greenish-purple, on very short pedicels; wings less than 1″ long, elliptical or obovate-elliptical, with a short claw, about five-veined, minutely mucronate, the mid-vein thickened at the tip; crest of keel very small, made up of a few papilloid processes; stamens eight in number; style very small, resembling that of the preceding species; mature capsule very small, shorter than broad; seeds minute, somewhat pear-shaped, dark-brown, hairy, the two caruncle-lobes about ⅓ the length of the seed.

Massachusetts.—Martha's Vineyard, 1825, Oakes. *Rhode Island.*—Thurber; 1846, Thurber and Calder; Providence, Olney. *New York.*—Long Island, Cedarhurst, 1886, J. A. Bisky. *Pennsylvania.*—Lanc. Co., New Texas, 1861, J. J. Carter; Chester Co., 1889, Witmer Stone; Philadelphia, 1844, ex. Herb. Dr. G. Watson; Bethlehem, J. Wolle; Franklin Co., Mercersburg, ex. Herb. Dr. Traill Green; near Bristol, 1865, C. F. Parker; Delaware Co., Tinicum, 1866, Thos. C. Porter; Pike Co., 1870, Thos. C. Porter; Chester Co., 1889, T. C. Porter; Lancaster Co., Smithville, 1865, T. C. P. *New Jersey.*—Nuttall, (dist. as *P. sanguinea*), (type); Pine Barrens, 1834; 1856, Dr. Short; 1861, Herb. Wm. M. Canby; Egg Harbor, 1889, Dr. J. B. Brinton; bet. Eatontown and Mechanicsville, 1865, T. F. Allen; Laurence Station, 1885, Rev. J. E. Peters. *Delaware.*—1866, Canby; Townsend, 1862, Herb.

Wm. M. Canby. *Maryland.*—Wm. M. Canby. *Kentucky.*—Hooker.

Type in Herb. Col. Coll.

22. P. SENEGA, L. Spec. Pl. 704, (1753).
Senega officinalis, Spach, Hist. Veg. vii. 129, (1839).

Stems, usually several from a thick rootstock, erect or ascending, straight or curved, 6′-18′ high, minutely puberulent, usually simple, occasionally branching above, leafy; leaves numerous, alternate, lanceolate, or some almost linear-lanceolate, ½′-1½′ long, scabrous on the margin, often a few, small and scale-like, at the bases of the stems; spikes cylindrical, 1′-1½′ long, 2″-4″ in diameter; flowers white or greenish-white, nearly sessile, wings circular-obovate, concave, 1″-1½″ long; crest of keel small, consisting of several short, thick processes; stamens eight in number; style short, galeate, or sharply curved, appendage wanting or represented by a minute tuft of hairs; mature capsule nearly orbicular, compressed; seeds obovoid, somewhat curved, only moderately hairy, the two caruncle-lobes rather broad, collateral, about as long as the seed.

Canada.—Rocky Mts., Canmore, 1885, Macoun; Saskatchawan, 1858, E. Bourgeau, No. 40; Manitoba, Assinaboine River, 1879, Macoun; Lake Winnipeg Valley, 1837, Bourgeau; E. coast of Hudson's Bay, 1879, Dr. Robert Bell, No. 23; Ontario, Belleville, 1865, 1867, 1878, Macoun.

Dakota.—Black Hills, 1887, Dr. W. H. Forwood; near Devil's Lake, "Nicollet's northwest. exped.," 1839, Chas. A. Geyer, (a stunted form).

Minnesota.—Minneapolis, 1886, O. W. Oestlund; Hennepin Co., 1890, ex. Herb. J. H. Sandberg.

Wisconsin.—Madison, T. J. Hale.

Maine.—Aroostook, 1882, Geo. U. Hay.

Vermont.—Colchester, Oakes; Charlotte, 1877, C. G. Pringle. *New York.*—Albany, Herb. Torrey; Watertown, 1834, Dr. Gray; Penn Yan, 1852, Sartwell; near Painted

Post, 1885, ex Herb. Isabel S. Arnold; Yates Co., Wright; "Hill opp. Tioga, W."

Pennsylvania.—Chester Co., Brookfield, 1861, Herb. Wm. M. Canby; Delaware Co., 1860, 1863, Wm. M. Canby; near Frankford, Conrad; Blair Co., Hollidaysburg, 1851, J. R. Lowrie; Huntingdon Co., near Alexandria, 1844; Chestnut Hill, ex Herb. Isaac Burk; Lanc. Co., New Texas, 1863; Conewago, 1889, J. K. Small.

Maryland.—Near Baltimore, 1867, R. V. LeRoy; Howard Co., Patapsco Valley, 1881, J. D. Smith; Garrett Co., 1885, J. D. Smith. *Virginia.*—Salt Pond Mt., 1890, A. Brown and others.

North Carolina.—Asheville, 1886, Thos. Hogg. "Mts. of Carolina and Georgia," S. B. Buckley. *Kentucky.*—Barrens of Green River, C. W. Short. *Tennessee.*—Cumberland Mts., 1842, Rugel. *Illinois.*—Menard Co., Mr. Hall; "Upper Mississippi," 1830, A. B. Eaton; "Franklin's Journey," Dr. Hooker, Herb. Torrey.

Gronovius' specimens on which the species is based in Herb. Mus. Brit. N. L. B.

Var. LATIFOLIA, Torr. and Gray, Fl. N. A., i. 131, (1838).

Leaves ovate-lanceolate or elliptical, acuminate, tapering at the base, 2'-4' long, 1'-1½' broad, margin serrulate.

Pennsylvania.—Delaware Co., 1863, 1873, Wm. M. Canby; Chaddsford, 1863, 1878, ex Herb. Wm. M. Canby. *Virginia.*—Bedford Co., 1871, A. H. Curtiss, (a peculiar form with lower leaves like the type and upper leaves like the variety).

Kentucky.—Cliffs of Kentucky River, 1834, Dr. Robert Peter; 1857, Dr. C. W. Short; Shakertown, Dr C. W. Short, (type); Cliffs of Elkhorn, near Frankfort, 1861, Dr. C. W. Short. *Tennessee.*—Currey, Wilkinson; Cumberland Mts., above Montgomery, 1842, Rugel. "Alleghany Mts." 1831, Herb. H. H. Eaton.

Type in Herb. Acad. Nat. Sci. Phila.

23. P. ALBA, Nutt. Genera, ii. 87, (1818).

P. Seneca, var. *tenuifolia*, Pursh, 750, (1814), not P. tenuifolia, Willd.

P. bicolor, H. B. K. Nov. Gen. v, 394, t. 507, (1821).

P. Torreyi, Don, Gardener's Dict., i. 360, (1831).

P. Beyrichii, Torr. and Gray, Fl. N. A. i. 130, (1838).

P. scoparia, Benth. Pl. Hartw. 8, (1839), not H. B. K.

P. aparinoides, Hook. and Arn. Bot. Beechey, 277, (1841) fide Seemann.

Glabrous throughout; stems several or many from a woody rootstock, erect or ascending, straight or somewhat curved, angled or grooved, 6′-18′ high, in most cases simple, occasionally sparingly branched above; leaves alternate, acute, linear, linear-lanceolate or linear-subulate, ½′-1′ long, or in some cases a few of the lower ones 2″-3″ long, oblanceolate, in apparent whorls; spikes conical, in some cases racemose, often long-peduncled, 2″-3″ in diameter at base, ½′-2′ long; bracts deciduous, the axis of inflorescence at length often much elongated, scarred; flowers white, on pedicels about ½″ long; wings obovate or oval, 1″-1½″ long; crest of keel fimbriate, the processes rather long and narrow; stamens eight in number; style short, minutely auriculate above the middle and above the pedicelled stigmatic gland, terminating above in a filiform, minutely tufted appendage; mature capsule more or less ovoid, 1″-1½″ long; seeds obovoid, hardly curved, covered with appressed silky hairs, the two caruncle-lobes about half as long as the seed.

Louisiana.—1842, Dr. C. W. Short, (dist. as *P. leptocaulis*, T. and G.); Bradbury, (dist. as *P. Seneca*, var. *tenuifolia*, probably Pursh's specimen). *Arkansas.*—ex Herb. Beyrich. *Missouri.*—Nuttall, (type); "Upper Missouri," 1853, Dr. Suckley; "Upper Missouri," 1874, Dr. Cowes; "Banks of Missouri," 1839, Nicollet's N. W. Exped., Chas. A. Geyer, No. 253. *Texas.*—Wright; 1844, F. Lindheimer, No. 220; Drummond, No. 27; Austin, Drummond, No. 4; Fort Worth, 1877, Reverchon, No. 709; 1880, J. Reverchon, No. 64; "Prairies along the Rio Grande," 1844, Dr. Meyer; Tom Green Co.,

1879, 1880, Frank Tweedy; "Western Texas to El Paso, New Mexico," 1849, C. Wright, No. 99.

New Mexico.—1847, A. Fendler, No. 110; 1851, C. Wright; Santa Magdalena Mts., 1881, G. R. Vasey; near Silver City, 1880, Ed. L. Greene; "Leavenworth to El Paso," F. A. Diffenderffer, Herb. Porter. "Mexican Bound. Survey," Dr. C. C. Parry and others, No. 192.

Kansas.—1884, Dr. J. H. Oyster; Fort Wallace, 1867, Dr. Wm. Bell; Ellis, 1874, L. Watson.

Nebraska.—1888, Dr. Wilcox; Crowelton, E. H. Miller, Herb. Wm. M. Canby. *Dakota.*—Herb. Phila. Acad. Sciences; "Prairies," 1883, Herb. University of Minn; Black Hills, 1887, Dr. W. H. Forwood; "Lit. Missouri River," 1882, Wm. M. Canby. *Arizona.*—Lemmon; "Rio Cienega, East of Tucson," 1877, E. L. Greene, No. 1079; Willowspring, 1874, Dr. Rothrock, No. 207; Fort Verde, Dr. Mearns, No. 327; "30 miles west of Big Spring," 1883, Holstein.

Washington.—"Columbia Plains," Nuttall. Lt. Beckwith's exped., No. 64. Long's 1st exped., Dr. James. "On the Platte," Dr. Le Conte.

24. P. SCOPARIA, H. B. K. Nov. Gen. v., 399, (1821).

P. scoparia, var. *multicaulis*, Gray, Pl. Wright. i. 38, (1852).

Stems, several or many from a thick rootstock, erect, 4'-18' high, straight or somewhat curved, irregularly branching, glabrous or more or less puberulent; leaves alternate, subulate-linear, 3''-6'' long, nearly erect; racemes ½'-1½' long; bracts deciduous; flowers greenish-white; wings about 1'' long, obovate or oval, narrowed below into a short claw; crest of keel made up of a few filiform processes; stamens eight in number; style short, open above and minutely auriculate between the stigmatic gland, which is provided with a few minute hairs, and the sessile tuft, the appendage wanting; mature capsule long-ovoid or oblong-ovoid, somewhat compressed, about 2'' long, usually provided with an indistinct wing on one margin from base to tip, most easily seen near the tip, the two cells usually unequal, the larger one being

that with the winged margin; seeds almost straight, short-clavate, minutely hairy, that in the larger cell somewhat larger, the two caruncle-lobes narrow, curved, flexuous, those of the larger seed about half as long as the seed, those of the smaller seed shorter.

Texas.—"Western Texas to El Paso, N. Mexico," 1849, Charles Wright, No. 100, (type of *P. scoparia*, var. *multicaulis*, Gray); "El Paso," 1881, G. R. Vasey, (No. 39)?; "Summit of Organ Mts." 1881, J. G. Lemmon.

New Mexico.—1851, C. Wright, No. 934; "Guadalupe Pass, Sonora," 1852, No. 934. *Arizona.*—Oak Creek, 1883, H. H. Rusby, No. 526; Foothills of the Santa Rita Mts., 1884, C. G. Pringle; "near Benson," 1880. Mexican Bound. Survey, Dr. C. C. Parry and others, No. 193.

25. P. HEMIPTEROCARPA, A. Gray, Pl. Wright. ii. 31, (1853).

Glabrous, or somewhat puberulent below; stems, often many from the same woody rootstock, erect, striate or angled, 6′-2° high, usually sparingly branched above, branches fastigiate; leaves alternate, mostly erect, subulate-linear, acute, ¼′-1′ long; racemes 1′-4′ long, often loosely flowered toward the base; bracts deciduous; flowers whitish, at length pendulous; wings 1″-2″ long, obovate or oval, narrowed into a short claw at the base, much shorter than the mature capsule; crest of keel made up of several thickish processes; stamens eight in number; style much as in the preceding species; mature capsule compressed, oblong-ovoid, 2″-2½″ long, the upper cell larger and furnished with a conspicuous wing on the margin from base to tip, which in some cases is almost ½″ broad; seeds straight, clavate, hairy, unequal in size, that in the larger cell larger, its two caruncle-lobes long, narrow, curved, flexuous, about two-thirds the length of the seed, that in the smaller cell smaller, apparently undeveloped, its two caruncle-lobes very short.

Texas.—"Dist. by P. V. LeRoy." *New Mexico.*—1851, C. Wright, No. 937, (type). *Arizona.*—Santa Rita Mts., 1884, C. G. Pringle, (dist. as *P. alba*, Nutt. or *P. scoparia*, H. B. K);

Southern Arizona, 1881, Lemmon, No. 501; Huachuca Mts., 1882, Lemmon, No. 2640; Mex. Bound. Survey, "near Camp Bache," 1852, C. C. Parry and others, (No. 194)?

Type in Herb. Gray.

The two species just described, *scoparia* and *hemipterocarpa*, are much alike; *hemipterocarpa* is a taller and stouter plant, its racemes are longer, its capsules somewhat larger with a large, well developed half-wing which is very small in the other plant; the two plants, however, have nearly the same range, and it is not easy to resist the impression that, in treating of the two, we are dealing with but one species.

26. P. POLYGAMA, Walter, Fl. Car. 179, (1788) ex descr.
P. rubella, Willd. Spec. Pl., iii. 875, (1800).

Glabrous throughout; stems several or many, 4′-20′ high, ascending, leafy, more or less striate, usually simple; leaves numerous, alternate, the lowest spatulate, a few lines long, the rest spatulate, oblanceolate or oblong, ½′-1′ long, usually mucronate, (in one specimen examined the upper leaves were narrowly oblong-obovate, 5″ broad); racemes loosely several to many-flowered, 1′-5′ long; flowers rose-purple, or, in forma *pallida*, pale pink, the lower ones at length pendulous on pedicels 1″-1½″ long, wings obovate, 2″-3″ long, longer than the corolla, venose, the two wings often unequal in size, crest of keel made up of several rather large, branched, somewhat winged processes; stamens eight in number; style short, dilated and cucullate, stigmatic gland pedicelled, tufted appendage short and strongly curved towards the stigmatic gland; mature capsule ovoid to oblong-ovoid, rather more than 1″ long; seeds thick, obovoid or ovoid, not curved, very hairy, the two caruncle-lobes conspicuous, parallel, broad, lace-like, almost ¾ the length of the seed. Inconspicuous, colorless, but fertile flowers are often borne on short prostrate stems which are sometimes subterranean.

Canada.—Ontario, near Castleton, 1865, Macoun; near Toronto, 1877, Macoun, (No. 374)?. *Maine.*—Orono, 1890, M. L. Fernald. *Massachusetts.*—Plymouth, Oakes; N. Truro,

1887, S. Watson; Nantucket, 1885, J. H. Redfield; Sconset, 1890, Mrs. Hubert; Martha's Vineyard, Edgartown, 1885, J. H. Redfield.

Rhode Island.—1846, Thurber and Calder; Smithfield, 1867, ex Herb. Olney; Block Island.

New York.—Oneida Lake, Dr. Torrey; Long Island, Montauk Point, 1865, Dr. T. Green; near Montauk Point, Cooper; Wading River, 1877, E. S. Miller; Hicksville Plain, 1890, Geo. D. Hulst; Cedar Hurst, 1886, J. A. Bisky; Garden City, 1886, Thos. Hogg. *New Jersey.*—Deal; Longacoming, 1862, Herb. Wm. M. Canby; Culver's Gap, 1886, N. L. Britton. *Pennsylvania.*—Near Philadelphia, 1844, ex Herb. Dr. G. Watson; West Philadelphia, "ex Herb. Coultas."

Maryland.—"Sandy Landing below Gt. Falls," 1879, Lester F. Ward. *West Virginia.*—Grafton, 1878, G. Guttenberg, (upper leaves 5″ broad).

South Carolina.—Santee Canal, H. W. Ravenel; Bluffton, Beaufort District, 1887, Dr. J. H. Mellichamp; Society Hill, 1878, Herb. Wm. M. Canby, a tall specimen, almost two feet high. *Georgia.*—Boykin, LeConte; Atlanta, 1869, Wm. M. Canby; Rock Mts., 1846; Macon, Mr. Loomis. *Florida.*—Chapman, Dr. Alexander; St. John's Co., 1882, J. D. Smith; Miami, 1877, Dr. A. P. Garber; New Smyrna, 1874, Dr. Edw. Palmer, No. 33. *Alabama.*—Miss R. L. P., Herb. C. W. Short, M. D. *Louisiana.*—Hale, ex Herb. C. Mohr; New Orleans, Dr. Ingalls. *Texas.*—1835, Drummond; 1836, Drummond, ex Herb. Shuttleworth, No. 24; (Bragos ?), 1844, Lindheimer; Hemstead, 1872, Elihu Hall, No. 94.

Illinois.—Dixon, "ex coll. Dr. Vasey.". *Wisconsin.*—Juneau Co., Camp Douglas, 1890, E. A. Mearns, No. 251; Lank Co., 1861, "ex coll. T. J. Hale." *Michigan.*—Fort Gratiot, Dr. Pitcher.

Forma PALLIDA, Hollick, Bull. Torr. Club, xviii. 256, (1891). Nantucket, 1885, J. H. Redfield. Long Island, Montauk Point, 1890, Arthur Hollick.

27. P. PAUCIFOLIA, Willd. Spec. Pl. iii. part 2, 880, (1800).

P. uniflora, Michx. Fl. ii. 53, (1803).

P. purpurea, Ait. f. Hort. Kew, iv. 244, (1812).

Triclisperma grandiflora, Raf. Speech. i. 117, (1814), fide Raf. Journal de Physique, lxxxix. 258, (1819).

Glabrous below; stems usually several, 2′-8′ high, slender, erect or ascending, striate, in most cases simple, arising from slender, creeping, often subterranean stems which often bear inconspicuous but fertile flowers; leaves alternate, all except the uppermost scattered, 1″-5″ long, the smallest bract-like; the uppermost 3-6 in number, clustered at the summits of the stems, ovate, oval or elliptical, acute, sometimes mucronate, ¾′-1½′ long, narrowed into a petiole 1″-3″ long, the upper portions of the stems, also the petioles, mid-veins and margins of the leaves often puberulent; flowers rose-purple, or, in forma *alba*, white, large, 6″-9″ long, showy, 1-4, axillary, but apparently in a terminal cluster, pedicels 5″-6″ long; wings obovate, attenuate at the base, venose, rather more than ½′ long, almost as long as the corolla; lateral petals oblong, concave; crest of keel conspicuous, fimbriate; stamens six in number; style long, enlarging slightly from below upwards, not cucullate or auriculate, without appendage, curved toward the tip which is slightly dilated and its margin denticulate, glabrous; mature capsule glabrous, compressed, somewhat circular in outline and retuse, or obcordate, about 3″ long; seeds hairy, caruncle-lobes two or three, subulate, in some cases longer than the seed.

Canada.—Lake Winnipeg Valley, 1837, Bourgeau; Ontario, near Trenton, 1870, Macoun; Missinaibi River, 1887, A. P. Low; New Brunswick, St. Stephen, 1881, Vroom; Ottawa Valley, Chalk River, 1884, Macoun.

Maine.—Raymond, J. Blake; Mt. Desert Island, 1888, Greenleaf, Lane and Rand; Orono, 1890, M. L. Fernald. *New Hampshire.*—North Conway, 1874, Morong; Centre Harbor, 1881, Joseph Schrenk; Belknap Co., 1863, 1864, J. Blake; Wilton, 1889, E. G. Britton. *Vermont.*—Miss Hapgood. *Massachusetts.*—H. Little; Westfield, Mr. Scott; Man-

chester, Oakes; Milton, 1875, Geo. E. Davenport. *Connecticut.*—East Hartford. *Rhode Island.*—Cumberland, Olney.

New York.—Watertown, 1834, Dr. Gray; Long Island, Sag Harbor; Glen Cove, 1876, Herb. J. Schrenk. *Pennsylvania.*—Mts., Wm. Darlington; Altoona, 1862, Herb. Wm. M. Canby; Huntingdon Co., Thos. C. Porter; Sullivan Co., 1864, Charles E. Smith; Monroe Co., Water Gap, 1870, Knipe; Centre Co., 1868, Rothrock; Lehigh Co., 1867, Garber; Huntingdon Co., Short Mts., 1844; Chester Co., 1861 and 1887, J. J. Carter; Tioga Co., Wellsboro, 1869, A. P. Garber; Northampton Co., Mt. Bethel, 1867, Dr. Meisell. *New Jersey.*—Washington, 1868, A. P. Garber; Franklin, 1890, H. H. Rusby; near Washington, 1868, Thos. C. Porter; Newfoundland, 1882, Herb. Jos. Schrenk. *Delaware.*—Mt. Cuba, 1890, Dr. J. B. Brinton. *Maryland.*—Garrett Co., 1878, J. D. Smith. "Yellowstone Park or Valley," 1888, Dr. Chas. H. Hall; "Alleghanies," 1832, Drummond, ex Herb. Shuttleworth.

Forma ALBA. Flowers white. *Pennsylvania.*—Pinegrove, 1860, J. R. Stauffer.

28. P. LINDHEIMERI, A. Gray, Bost. Journ. Nat. Hist. vi. 150, (1857).

Pubescent, or in some cases merely puberulent; stems, several or many from a thick woody root, erect or ascending, 2′-12′ high; leaves numerous, alternate, sessile or with very short petioles, somewhat coriaceous, reticulately veined, cuspidate, 4″-9″ long, the lowest obovate, the rest ovate, oval, elliptical or lanceolate, more or less pubescent or puberulent, minutely glandular; flowers in loose, few-flowered racemes which are terminal, or at length lateral, the rachis slender, more or less geniculate, with a persistent cluster of three bracts, one larger and two smaller, at each angle, pedicels very short, wings about 2½″ long, oval-obovate, venose, about as long as the keel, lateral petals long, narrow, sometimes emarginate or mitten-shaped above, somewhat concave, reaching to the tip of the beak of the keel, keel cucullate and provided with a

slender, hardly curved beak about ½″ long; stamens eight, or in some cases seven, in number, filaments connected almost to the anthers, somewhat dilated near the anthers; ovary pubescent; style long, slender, flexuous, curved above, neither auriculate nor cucullate, somewhat dilated near the tip which has a minutely denticulate margin; mature capsule compressed, oblong-ovoid, 3″ or more long, slightly emarginate, puberulent, the upper sepal a little removed from the rest of the flower and often persistent; seeds obovoid, somewhat compressed, covered with dense, spreading hairs, the two caruncle-lobes narrow, rather more than half as long as the seed.

Texas.—Charles Wright; 1846, Lindheimer; 1847-1848, Lindheimer, No. 333, (type); Blanco, J. Reverchon, No. 63; near Comanche, 1877, Reverchon, No. 708; Austin, 1872, Elihu Hall; Fort Stockton, 1860, Patrick Duffy; Western Texas, 1851-1852, C. Wright, No. 1349; Maxon Spring, 1883, Havard, No. 100; Western Texas to El Paso, New Mexico, 1849, Charles Wright, No. 102. *New Mexico.*—1851-1852, C. Wright, No. 1349. "Mexican Boundary Survey," C. C. Parry and others, No. 190. "Upper Guadaloupe," 1845, Nos. 337 and 500. "Eagle Pass and Rio Grande," 1848, Wright.

Type in Herb. Gray.

* Var. PARVIFOLIA, n. var.

Puberulent; leaves all about the same size, small, elliptical or narrowly lanceolate, 3″-4″ long; mature capsule smaller and, especially, shorter than in the type.

Arizona.—Foothills of the Santa Rita Mts., 1884, C. G. Pringle, ex Herb. J. D. Smith.

29. P. TWEEDYI, Britton, n. spec.

Puberulent throughout; stems, several from a curved or twisted root-stock, 8′ high, or less, slender, erect or ascending, more or less curved, leafy to the top, in most cases simple; leaves alternate, erect, sessile, ½′-1′ long, linear to linear-lanceolate, acute, or the lowest oblanceolate; flowers small, about 2″ long, few, rachis slightly geniculate, resembling somewhat that in the preceding species, wings obovate, some-

* In Herb. M. B. G.

what concave, venose, about as long as the corolla, keel provided with a slender beak about ½″ long, stamens, in the only flower examined, 6, or perhaps 7, filaments united half way to the anthers; style long, rather slender, curved, neither cucullate, auriculate nor dilated, stigmatic gland terminal, somewhat bilabiate; mature capsule about 2½″ long, compressed, longer than broad, puberulent; seeds compressed-obovoid, hairy, two of the three caruncle-lobes cartilaginous, diverging, about half as long as the seed, the third very short.

Texas.—Tom Greene Co., 1879, Frank Tweedy, (type). Perhaps also a plant in Herb. Canby, almost glabrous, about 6′ high, "ex Herb. Gray, Gray, Pl. W.," (dist. as *P. puberula*), and another, also in Herb. Canby, "Texas, dist. by P. V. Le Roy," (dist. as *P. Lindheimeri*, Gray).

Type in Herb. Col. Coll.

30. P. ACANTHOCLADA, A.Gray, Proc. Am. Acad. xi. 73, (1876).

More or less cinereous-pubescent, almost shrubby, two feet or less in height, the branchlets terminating in slender spines which are sometimes compound; leaves linear-spatulate or linear-oblanceolate, 3″-6″ long, alternate, scattered; flowers subaxillary, few, white, or whitish, about 2″ long, the bracts at the base of each pedicel two in number, wings obovate, keel short, cucullate, with a short, conical, blunt beak, or, in some cases, the beak represented by a mere ridge.

Colorado or Utah.—San Juan River, 1875, T. S. Brandegee, (type). *Colorado.*—"On the San Juan, near the Utah line," 1875, T. S. Brandegee, No. 1172, Herb. Porter. *Arizona.*—S'ta. Catalina Mts., 1881, J. G. Lemmon, No. 601. *Nevada.*—Esmeralda Co., Candilaria, 1881, W. H. Shockley.

Type in Herb. Gray.

31. P. SUBSPINOSA, S. Watson, Am. Nat., vii. 299, (1873).

Glabrous or somewhat pubescent; stems numerous, 2′-8′ high, branched above, the branches usually spinose; leaves alternate, scattered, in most cases few, spatulate, oblong or

linear-lanceolate, ½′-1′ long, obtuse or acute; flowers few, in a loose raceme, wings oblong, 4″-5″ long, rose-colored, lateral petals linear, as long as the keel, keel cucullate, yellowish, provided with a thick, blunt beak which is rather short and not erect; capsule obovate, emarginate, about 3″ long; seeds hairy.

Nevada.—Near Silver City, 1862, Kellogg, (type). *Southern Utah.*—1873, Capt. Bishop; Kanab, Mrs. Thompson; "Southern Utah, etc.," 1874, Dr. C. C. Parry, No. 32; "Southern Utah, Northern Arizona, etc.," 1877, Dr. E. Palmer, No. 50.

Type in Herb. Gray.

32. P. Rusbyi, Greene, Bull. Torr. Bot. Club, x. 125, (1883).

Hoary-pubescent; low; stems, several or many from a woody rootstock, 2′-6′ long, rather stout, branching, spreading, reclining or decumbent, leafy, without spines; leaves alternate, numerous, nearly or quite sessile, 3″-8″ long, canescent, the largest about 3″ broad, elliptical, or obovate-elliptical, in most cases acute; racemes loosely 4-8 flowered, bracts scarious-margined, ciliate, pedicels 2″-3″ long; flowers showy, 4″-5″ long, the lowest often pendulous, wings somewhat concave, narrowly obovate or oblong, venose, flesh-colored or purplish, somewhat longer than the keel, lateral petals often longer than the keel, narrow, venose, in some cases retuse, keel yellowish, provided with a rather large, almost straight, blunt beak; stamens eight in number, anthers emarginate at summit; style long, curved, broadening somewhat above, neither cucullate nor auriculate, stigma indistinctly bilabiate, the lower lip often minutely bearded beneath.

Arizona.—1870, Dr. Palmer; near Prescott, 1883, H. H. Rusby, (type); Prescott, 1876, Dr. E. Palmer, No. 34, (dist. as *P. subspinosa*, Watson); Peach Springs, 1884, J. C. Lemmon; Marcus E. Jones, (dist. as *P. subspinosa*, Watson); Banghart's Ranche, 1883, H. H. Rusby, No. 525; Fort Verde, Dr. E. A. Mearns, (No. 323 ?).

The above species is referred to, in the original descrip-

tion of *P. subspinosa*, Watson, as a densely pubescent but spineless form of the same.

Authentic specimen in Herb. Col. Coll.

33. P. CUCULLATA, Benth. Pl. Hartw. 299, (1849).

P. Californica, Nutt., Torr. and Gray, Fl. i. 671, (1840).

P. Nutkana, Torr. and Gray, Fl. i. 671, (1840).

Glabrous, or puberulent above; stems slender, curved, reclining or ascending, 2′-12′ long, simple, or branched above; leaves alternate, glabrous, or puberulent, at least on the mid-vein on the under surface of the leaf, ovate-elliptical, elliptical or oblong-lanceolate, ½′-1½′ long, acute or obtuse, in some cases cuneate at base, petioles hardly more than ½″ long; flowers rose-colored, few, rarely more than ten, 5″-6″ long, in a raceme terminating the stem or branches, pedicels 1″-3″ long, sepals minutely ciliate on the margin, otherwise nearly glabrous, wings spatulate, almost as long as the keel, lateral petals linear-lanceolate, as long as, or even longer than the keel; keel bearing a rather conspicuous, stout, curved, blunt beak; stamens eight in number, filaments united for the lower two-thirds of their length, filiform above; style long, rather slender, much curved above, neither cucullate nor auriculate, stigma obscurely bilabiate, minutely bearded on the lower lip; mature capsule glabrous, or nearly so, compressed, oval to ovate, about 4″ long, retuse between the tips of the narrow, veined, wing-like margins of the capsule; seeds only slightly hairy, the caruncle-lobes united, somewhat bonnet-shaped, about one-third as long as the seed.

California.—Hartweg, Dr. Gibbons; 1872, Miss Mary J. Bancroft; Santa Cruz, 1865, C. L. Anderson; 1882, C. C. Parry; Monterey, Andrews; 1850, Dr. C. C. Parry; Ukiah, 1864, H. N. Bolander, No. 3917; 1882, C. Purdy; Napa Valley, 1865, J. Torrey, No. 76; near San Francisco, 1865, J. Torrey; Marin Co., 1880, G. R. Vasey, No. 41; Mariposa, 1883, T. Meehan; Summit Mt. Tamaulpais, 1874, J. G. Lemmon, No. 486; Bolinas Bay Hills, 1866, Kellogg, (Geol. Survey of Cal.).

Oregon.—Josephine Co., 1876, L. W. Lee; Waldo, 1884, Thomas Howell.

34. P. CORNUTA, Kellogg, Proc. Calif. Acad., 1. 61, (1855), fide Greene.
P. Californica, Brew. & Wats. Bot. Cal. i. 59, (1876), (not Nutt).

Glabrous, or nearly so, 6′–18′ high, stout, often much branched; leaves alternate, almost or quite glabrous, ovate, elliptical, lanceolate, or some of the smaller ones obovate, obtuse and more or less mucronate, or, in some cases, slightly retuse, ½′–1½′ long, 3″–7″ broad, nearly sessile; flowers in racemes terminating the stems, greenish-white, 4″–5″ long, pedicels about 2″ long; bracts often persisting for some time; in most cases all the sepals tomentose, wings oblong, venose, hardly as long as the keel; keel much as in the preceding species but its beak acicular, erect; lateral petals shorter than in the preceding species, not reaching the tip of the beak; stamens eight in number; style much as in the preceding species; mature capsule compressed, about 5″ long, broadly ovate or somewhat circular in outline, retuse or emarginate; seeds densely hairy.

California.—Nuttall, Rev. Mr. Fitch; Santa Barbara Co., 1865, J. Torrey; Los Angeles Co., St. Anita Cañon, 1883, J. C. Nevin, No. 849; Siskiyou Co., 1881, C. G. Pringle; 1876, E. L. Greene, No. 1011; Scott Valley, Callahan's Ranch, 1876, E. L. Greene, No. 1011; Plumas Co., 1875, Mrs. M. E. P. Ames; 1876, Mrs. Ames, Herb. Wm. M. Canby; Butte Co., 1878, Mrs. J. Bidwell; San Diego Co., Jamuel Valley, 1875, Dr. Ed. Palmer, No. 19, (dist. as *P. cucullata*, Benth); "Upper Sacramento," 1838–1842, Herb. U. S. South Pac. Explor. Exped., No. 1595; "Frémont's Exped. to Calif.," 1845–1847; "Geol. Survey of Calif.," 1860–1862, near Mt. Shasta, W. H. Brewer, No. 1369; "Geol. Survey of Calif.," 1866, Rattan; "P. R. R. Surv. Calif. and Oregon, foot of Mt. St. Joseph's," Dr. J. S. Newberry.

35. P. MACRADENIA, A. Gray, Pl. Wright., i. 39, (1852).

Cinereous-pubescent; 2′–10′ high; stem very stout, woody, twisted, procumbent, much branched; leaves alternate, very numerous, oblong or oblong-lanceolate, 2″–3″ long, obtuse, densely cinereous-pubescent, with comparatively large, roundish, black or yellowish-brown glands, more numerous upon the under surface; flowers solitary, scattered, almost sessile; wings 2″–2½″ long, obovate or oblong-obovate; lateral petals as long as, or longer than, the keel, narrow, curved near the truncate or retuse tip; keel somewhat three-lobed, naked, without crest or beak; stamens eight in number, filaments united almost to the anthers; style slender, curved above the middle, not dilated, neither cucullate nor auriculate; mature capsule ovate, compressed, about 3″ long, emarginate, puberulent; seeds narrowly obovoid, curved, densely appressed-hairy, caruncle helmet-shaped or miter-shaped, with three short, acute lobes

Texas.—1851, Geo. Thurber; C. Wright, No. 101; "Rio Grande," 1848, Wright; El Paso, 1881, G. R. Vasey; 1858, F. Dieffenderffer, No. 76; "Western Texas to El Paso, New Mexico," 1849, Chas. Wright, No. 101. *New Mexico.*—1851—1852, C. Wright, No. 1348. *Arizona.*—Santa Cruz, 1884, W. F. Parish; "Hills near Tucson," 1883, C. G. Pringle; "Camp Grant," 1867, Dr. Ed. Palmer; "Santa Catalina Mts.," 1881, J. G. Lemmon, No. 125.

Type in Herb. Gray.

36. P. OVALIFOLIA, A. Gray, Pl. Wright., i. 39, (1852).

Velvety-pubescent; 3′–10′ high; stems few or many from a stout, woody base, erect or ascending, flexuous, leafy to the summit, simple or branching; leaves numerous, alternate, 4″–1′ long, the lower, smaller ones round-ovate, the larger ovate, oval or ovate-elliptical, the uppermost often ovate-lanceolate, acute, the rest more or less obtuse, though often mucronate, both surfaces, but especially the lower, more or less papillose and pubescent, the margin spreading-ciliate, petioles very short; flowers greenish-yellow, the lower

pendulous, in rather crowded, 12 to 25 flowered racemes terminating the stems and branches; pedicels 1″–2″ long; wings about 2½″ long, oval, the outer surface pubescent or puberulent, the margin ciliate, shorter than the keel which they do not cover or conceal; lateral petals much shorter than, often only one-half as long as, the keel; keel mostly uncovered, the most conspicuous part of the flower, 3″–4″ long, naked, without crest or beak; stamens eight in number; style slender, curved, neither dilated, cucullate nor auriculate, stigma apparently two-lobed and bearded between the lobes which are somewhat separated; mature capsule compressed, almost circular in outline, 5″–6″ long, deeply emarginate, surfaces glabrous, margin ciliate; seeds with a short, bonnet-shaped caruncle.

Texas.—Rio Grande, 1848, Wright, (type); "dist. by P. V. Le Roy," in Herb. Canby; Uvalde Co., 1885, J. Reverchon, No. 1492, (dist. as *P. ovalifolia*, D.C.); San Diego, 1884–1888, Miss Mary B. Croft, No. 29; Western Texas, "on the Sabinal," 1885, J. Reverchon, No. 12, (dist. as *P. ovalifolia*, D.C.); Western Texas, 1851, C. Wright, No. 935; "Western Texas to El Paso," 1849, Chas. Wright, No. 103.

New Mexico.—1851, C. Wright, No. 935. Mexican Bound. Survey, C. C. Parry and others, No. 191. *Mexico*.—Monterey, "Edwards and Eat.", (ex Herb. J. Torrey); 1880, Dr. Ed. Palmer, No. 65. Type in Herb. Gray.

This plant was at first taken for *P. ovalifolia*, D.C., by Dr. Gray in Pl. Lindh., ii. 151, but the distinction between the two is clearly indicated by him in Pl. Wright., as above.

P. ovalifolia, D.C., is not pubescent, but puberulent or almost glabrous, the veins on the under surface of the leaves stand out prominently, the racemes are, in most cases, made up of fewer and more erect flowers, the wings are as long as, or even longer than, the keel which they almost conceal, the narrow lateral petals are almost as long as the keel, and, according to DeCandolle, the surfaces of the capsule are pubescent. The only specimens seen by the writer are from Mexico, and, therefore, not within the limits of this paper.

37. P. PUBERULA, A. Gray, Pl. Wright. i. 40, (1852).

Puberulent; stems erect or ascending, 6′–18′ high, somewhat flexuous, in most cases branched, branches erect; leaves numerous, alternate, linear-lanceolate to lanceolate, ½′–1′ long, almost sessile, puberulent, often mucronate; flowers purplish or bluish, in open, rather few-flowered racemes which may become several inches long, fertilized flowers, and capsules, pendulous, pedicels about 1″ long, floral envelopes early deciduous; wings obovate, ciliolate, 2″–3″ long, in most cases somewhat appressed to, and almost as long as, the keel; lateral petals broad, obtuse, almost spatulate, in some cases slightly emarginate, considerably shorter than the keel; keel naked, without crest or beak; stamens eight in number, filaments united almost to the anthers; style slender, curved, neither dilated, cucullate nor auriculate, stigma two-lobed, not bearded; mature capsule compressed, oval, or almost circular in outline, emarginate, about 4″ long, the surfaces glabrous, or in some cases puberulent, the margin sparsely ciliate, the immature capsule somewhat obovate; seeds obovoid, hairy, the caruncle-lobes forming three lacerate, somewhat curved processes, about one-quarter the length of the seed.

Texas.—P. V. Le Roy; Western Texas, Bofecillos Mts., 1881, V. Havard, No. 102, (18′ high, leaves erect, probably *P. puberula*); Foot-hills Bofecillos Mts., 1883, V. Havard, No. 99, and Chisos Mts., 1883, V. Havard, No. 98, (leaves linear, 3″–10″ long, perhaps a variety); Western Texas to El Paso, 1849, Chas. Wright, No. 104.

New Mexico.—1851–1852, C. Wright, No. 936, (type); 1851, ex coll. Geo. Thurber, 1871, F. R. Diffenderffer, (probably *P. puberula*); Mangus Springs, 1881, H. H. Rusby, No. 33, and, in Herb. J. D. Smith, Mogollon Mts., 1881, Henry H. Rusby, No. 31, (probably *P. puberula*); "near Silver City," 1880, E. L. Greene.

Arizona.—"Ash Ck.," 1874, Dr. J. T. Rothrock, No. 312; "near Tucson, Sa. Catalina Mts.," 1881, J. G. Lemmon, No. 124; "Camp Bowie," 1874, Rothrock, No. 459; Foot-hills of

Santa Rita Mts., 1882, C. G. Pringle, No. 20; Foot-hills of Santa Rita Mts., 1884, C. G. Pringle; "Bower's Ranch," Dr. Palmer, (probably *P. puberula*); "Beaver Head," 1883, H. H. Rusby, No. 527, (probably *P. puberula*).

Mexican Bound. Survey, C. C. Parry and others, No. 189. Type in Herb. Gray.

38. P. GRANDIFLORA, Walt. Fl. Car. 179, (1788), ex descr.
P. Senega, var. *rosea*, Michx. Fl. ii. 53, (1803).
P. pubescens, Muhl. Cat. 66, (1813).
P. Muhlenbergii, Don, Gard. Dict. i. 358, (1831).

Pubescent; stems several, or in some cases only one, rather slender, 8′–20′ high, ascending, slightly curved, simple or branching, leafy to the top; leaves alternate, linear-lanceolate to lanceolate, or some of them almost elliptical, often mucronate, slightly pubescent, especially near the margin, ½′–1½′ long, on very short petioles; flowers rose-color or purplish, becoming greenish, scattered, often distant, the lower ones mostly drooping, in elongated racemes, often several inches in length, the recurved pedicels about 2″ long; wings persistent, circular-deltoid, comparatively large, 3″-4″ broad, short-clawed, glabrous, conspicuously venose, covering and more or less concealing the corolla or the capsule; lateral petals venose, dilated above, or spatulate, much shorter than the keel; keel naked, without crest or beak, more or less plicate at the sides below, cucullate, with sometimes a slight callosity at the tip; stamens eight in number, filaments slender, united only below the middle; style slender, bent near the middle at an acute angle, somewhat dilated below, neither cucullate nor auriculate, minutely bearded for a short distance below the stigma; mature capsule compressed, obovoid or oblong-obovoid, emarginate, 2½″-3″ long, glabrous, or nearly so; seeds oblong-ovoid, somewhat compressed, very hairy, hairs silky, caruncle cartilaginous, helmet-shaped with three short projections, conspicuous.

South Carolina.—Charleston, Dr. Bachman; Society Hill. 1878, Herb. Wm. M. Canby, and 1884, J. D. Smith; Bluffton,

Beaufort Dist., 1873 and 1886, Dr. J. H. Mellichamp. *Georgia.*—Le Conte, Baldwin. *Florida.*—Dr. Torrey, Mr. Ware, Dr. A. W. Chapman, Mrs. Treat, and 1875, Mary C. Reynolds; Indian River, 1874, Dr. Ed. Palmer, No. 31; Hibernia, 1869, Wm. M. Canby; Manatee Co., 1887, Dr. J. T. Rothrock; Fort Meade, 1880, J. D. Smith; Tampa, Bay, 1845, Rugel, No. 39; Tampa, 1880, J. D. Smith; "near Jacksonville," A. H. Curtiss, No. 513; Miami, 1877, Dr. A. P. Garber; Keys, Sarasota, 1876, Dr. A. P. Garber; Key West, Blodgett. *Alabama.*—Gates. *Mississippi.*—Columbus, 1890, S. M. Tracy.

Var. ANGUSTIFOLIA, Torr. and Gray, i. 671, (1840).

Leaves linear, almost glabrous, flowers usually somewhat smaller.

Florida.—Dr. Leavenworth, Dr. A. W. Chapman; Lake Astachusa, Sumter Co., 1879, J. D. Smith; "near St. Marks," 1843, Rugel; Key West, 1846, Rugel, No. 37, (dist. as *P. flabellata*, Shuttl.); Miami, 1877, Dr. A. P. Garber; Biscayan Bay, 1874, Dr. Ed. Palmer, No. 32; Pine Key and Key West, Blodgett.

Type in Herb. Col. Coll.

In his Flora of North America, Part iv. pp 88-90, (1836), Rafinesque describes seven species under the generic names *Asemeia* and *Polygala*. I have not been able to find authentic specimens of any of them, and his descriptions are not sufficient for their positive identification.

Besides the specimens contained in the Herbarium of Columbia College, there have been examined, in the preparation of this paper, those in the Gray Herbarium at Cambridge, the Herbarium of the Academy of Natural Sciences of Philadelphia, and that of the Geological and Natural History Survey of Canada, and also those in the Herbaria of Prof. Thomas C. Porter, Capt. John Donnell Smith and Mr. Wm. M. Canby.